W. Henry Price

THE SENSES

AND

THE INTELLECT.

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THE SENSES

AND

THE INTELLECT.

BY

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PREFACE.

THE object of this treatise is to give a full and systematic account of two principal divisions of the science of mind,—the Senses and the Intellect. The remaining two divisions, comprising the Emotions and the Will, will be the subject of a future treatise.

While endeavouring to present in a methodical form all the important facts and doctrines bearing upon mind, considered as a branch of science, I have seen reason to adopt some new views, and to depart, in a few instances, from the most usual arrangement of the topics.

Conceiving that the time has now come when many of the striking discoveries of Physiologists relative to the nervous system should find a recognized place in the Science of Mind, I have devoted a separate chapter to the Physiology of the Brain and Nerves.

In treating of the Senses, besides recognizing the so-called muscular sense as distinct from the five senses, I have thought proper to assign to Movement and the feelings of Movement a position preceding the Sensations of the senses; and have endeavoured to prove that the exercise of active energy, originating in purely internal impulses, independent of the stimulus produced by outward impressions, is a primary fact of our constitution.

Among the Senses have been here enrolled and described with some degree of minuteness, the feelings connected with the various processes of organic life,—Digestion, Respiration, &c.—which make up so large a part of individual happiness and misery.

A systematic plan has been introduced into the description of the conscious states in general, so as to enable them to be compared and classified with more precision than heretofore. However imperfect may be the first attempt to construct a Natural History of the Feelings, upon the basis of a uniform descriptive method, the subject of Mind cannot attain a high scientific character until some progress has been made towards the accomplishment of this object.

In the department of the Senses, the Instincts, or primitive endowments of our mental constitution, are fully considered; and in endeavouring to arrive at the original foundation, or first rudiments, of Volition, a theory of this portion of the mind has been suggested.

In treating of the Intellect, the subdivision into faculties is abandoned. The exposition proceeds entirely on the Laws of Association, which are ex-exemplified with minute detail, and followed out into a variety of applications.

London, *June*, 1855.

PREFACE TO THE SECOND EDITION.

THIS edition has been thoroughly revised, and in many places re-written. Although I have not seen reason to change any of my leading views on the subject of mind, I hope I may have succeeded in improving the statement and exposition of them.

It is in the first part of the work where most alteration has been made. The explanations of the Nervous system and the Senses have been amended according to the best recent authorities on Physiology. The Definition of Mind has been somewhat differently expressed. The systematic plan of describing the Feelings has been modified, and all the detailed descriptions re-cast. An attempt has been made to generalize the Physical accompaniments of Pleasure and Pain. The Instinctive foundations of Volition are stated more explicitly.

In the second part, the Introduction to the Intellect has been revised, with a view to rendering as precise as possible the natural subdivisions of this portion of the mind. The doctrine referring to the physical seat of revived impressions has been discussed anew, and applied to clear up the difficulties attending the explanation of Sympathy. The associating principle of Contrast has, on farther consideration, been treated as the reproductive aspect of Discrimination, or Relativity.

The origin of our notions of Space and Time has been more minutely traced; and some additions have been made to the handling of the great Metaphysical problem, relating to the External World.

ABERDEEN, *February*, 1864.

PREFACE TO THE THIRD EDITION.

IN this third edition, the work has again been subjected to a thorough revision, involving numerous amendments both in matter and in style.

The sketch of the Nervous System, and the Physiological references generally, have been compared with the statements given in the newest works. The Reflex Actions, illustrating the Will, by contrast and by resemblance, are more fully and systematically discussed.

In the Intellect, the fundamental conditions, both of Retentiveness and of Similarity, have been set forth with greater precision; whereby clearness is gained in following out the details of those great leading functions.

The value of the work is greatly enhanced by an account of the Psychology of Aristotle, which has been contributed by Mr. Grote. The chief significance of Aristotle's views, at the present day, lies in his recognizing, in an almost unqualified manner, the double-sidedness of the mental states.

ABERDEEN, *September*, 1868.

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INTRODUCTION.

CHAPTER I.

DEFINITION AND DIVISIONS OF MIND.

1. THE operations and appearances that constitute MIND are indicated by such terms as Feeling, Thought, Memory, Reason, Conscience, Imagination, Will, Passions, Affections, Taste. But the Definition of Mind aspires to comprehend in few words, by some apt generalization, the whole kindred of mental facts, and to exclude everything of a foreign character.

Mind is commonly opposed to Matter, but more correctly to the so-called External World. These two opposites define each other. To know one is to know both. The External, or, in more philosophical language, the Object, World is distinguished by the property called Extension, pertaining both to resisting Matter, and to unresisting, or empty Space. The Internal, or the Subject, World is our experience of everything not extended; it is neither Matter nor Space. A tree, which possesses extension, is a part of the object world; a pleasure, a volition, a thought, are facts of the subject world, or of mind proper.

Thus Mind is definable, in the first instance, by the method of contrast, or as a remainder arising from subtracting the Object World from the totality of conscious experience. It happens that the Object World is easily defined or circumscribed; the one well-understood property, Extension, serves for this purpose. Hence the alternative, or the correlative Mind, can be circumscribed with equal exactness. But this negative definition, although precise, so far as it goes, fails to indicate the full scope of the enquiry. Even after the substitution of the correcter phraseology,—Subject and Object for Internal and External,—we have to admit that Object Experience is still conscious experience, that is, Mind; and, although the development of the object properties belongs to other sciences, yet the foundations or beginnings of them must be traced in mental science. Now, it has been found possible to sum up all the properly mental phases in a small number of general properties, whose enumeration (which is strictly speaking a Division) is all that can be offered as a positive Definition of Mind.

2. The phenomena of the Unextended, or Subject Mind, are usually comprehended under three heads:—

I. FEELING, which includes, but is not exhausted by, our pleasures and pains. Emotion, passion, affection, sentiment —are names of Feeling.

II. VOLITION, or the Will, embracing the whole of our activity as directed by our feelings.

III. THOUGHT, Intellect, or Cognition.

Our SENSATIONS, as will be afterwards seen, come partly under Feeling, and partly under Thought.

The three classes of phenomena have each certain distinctive characteristics, and the sum of all these is a definition of mind, by a positive enumeration of its most comprehensive qualities. There is no one fact or property that embraces all the three. We may have a single *name* for the whole, as Mind, the Subject, the Unextended, Self-Consciousness; but it does not follow that one general property shall exhaust the whole. Volition is a distinct fact from Feeling, although presupposing it; and Thought is not necessarily implied in either of the two other properties.

3. A few remarks may here be offered, by way of elucidating this threefold definition and division.

First. For a notion of what FEELING is, we must refer each person to their own experience. The warmth felt in sunshine, the sweetness of honey, the fragrance of flowers, the beauty of a landscape, are so many known states of feeling.

Our pleasures and pains are all included under this head; but many other states, both simple and complex, that are neutral as regards pleasure and pain, must also be referred to it. The entire compass of our Feelings could be known only by an exhaustive enumeration; from which also we might expect to obtain a general definition of Feeling. It is not requisite at this stage that we should either classify the feelings, or arrive at their common or defining properties. It so happens, that we can readily circumscribe this part of our mental being, by that negative method already exemplified in the definition of mind as a whole: for the characters both of thought and of volition are remarkably intelligible and precise, and therefore give us a ready means of laying down the boundary of the remaining department.

We may, however, remark, before passing to the consideration of the other divisions, that the presence of Feeling is the foremost and most unmistakable mark of mind. The members of the human race agree in manifesting it. The different orders of the brute creation show symptoms of the same endowment. The vegetable and mineral worlds are devoid of it. True, it is each in ourselves that we have the direct evidence of the state; no one person's consciousness being open to another person. But finding all the outward appearances that accompany feeling in ourselves to be present in other human beings, and, under some variety of degree, in the lower animals, we naturally conclude their mental state to be similar to our own. The gambols of a child, the smile of joy, a cry on account of pain, and the corresponding expressions for mental states common to all languages, prove that men in every age and nation have been similarly affected. The terms for expressing pleasure and pain in their various forms and degrees, are names of feelings; joy, happiness, bliss, comfort, sorrow, misery, agony—are a few examples out of this part of the vocabulary.

Secondly. All beings recognized as possessing mind can not only feel, but also ACT. The putting forth of force to attain some end marks a mental nature. Eating, running, flying, sowing, building, speaking—are operations rising above the play of feeling. They all originate in some feelings to be satisfied, which gives them the character of proper mental actions. When an animal tears, masticates, and swallows its food, hunts its prey, or flees from danger, the stimulus or support of the activity is furnished by its sensations or feelings. To this feeling-prompted activity we give the name *Volition.*

The characteristic of being stimulated by the feelings of sentient beings makes a wide contrast between volition and the energies familiar to us in nature,—the powers of wind, water, gravity, steam, gunpowder, electricity, vegetation, &c. For although the strong personifying tendency of mankind has often compared these powers to a human will, yet in reasoning about them scientifically no such comparison is admitted ; while, in the explanation of voluntary actions, the reference to feeling and to thought is indispensable.

Volition is farther contrasted with such animal functions as breathing, the circulation of the blood, and the movements of the intestines. These are actions, and serve a purpose, but they are not mental actions. We could imagine ourselves so constituted, that these processes would have had to be prompted and controlled by sensations, emotions, and desires ; they would then have been mental actions. As it is, they form a class apart, denominated Reflex Actions. When narrowly examined, they appear to shade by insensible degrees into voluntary actions ; but we are not on that account to confound the broad and fundamental distinction between the unconscious and the conscious, involved in the opposition of the reflex and the voluntary.

It is impossible, in a brief preliminary sketch, to indicate and discriminate all the varieties of animal activity. There is a complication to be unravelled in this department of the mind, such as to test severely the resources of mental science.

It is sufficient to remark, as the most general law of volition, that pleasure prompts to action for its continuance, increase, or renewal; and that pain prompts to action for its cessation, abatement, or prevention.

Thirdly. The concluding attribute of the mental constitution is THOUGHT, Intelligence, or Cognition. This includes such functions as Memory, Reason, Judgment, and Imagination. The first fact implied in it is *Discrimination*, or sense of difference, shown by our being conscious of one sensation as more intense than another, or when we are aware of two feelings as differing in kind,—for example, taste and smell, pain and pleasure, fear and anger. Another fact is *Similarity*, or sense of agreement, which is interwoven with the preceding in all the processes of thought. When we identify any sensation or present mental impression with one that occurred previously, there being an interval between, we exemplify the power of similarity; the sun seen to-day recalls our previous impressions of his appearance. A third fact or property of the Intellect is *Retentiveness*, commonly understood by the familiar names 'memory' and 'recollection.' This power is essential to the operation of the two former powers; we could not discriminate two successive impressions, if the first did not persist mentally to be contrasted with the second; and we could not identify a present feeling with one that had left no trace in our framework. Retentiveness, which sums up all that we designate by memory, acquisition, education, habit, learning by experience, is not wanting in the lower orders of sentient life. For an animal to have a home, a certain degree of memory is requisite.

We have seen that Volition is separated from Feeling, by superadding the characteristic of *action*, or the putting forth of energy to serve an end. And now, after the foregoing enumeration of Intellectual attributes, we can draw the line between Thought and Feeling, which is to complete the definition of mind, so far as is needful at the outset.

In proportion as a mental experience contains the facts named discrimination, comparison, and retentiveness, it is an Intellectual experience; and in proportion as it is wanting in these, and shows itself in pleasure or pain, it is of the nature of Feeling. The very same state of mind may have both an intellectual side and an emotional side; indeed, this is a usual occurrence. And, like many things that are radically contrasted, as day and night, these two distinct facts of our nature pass into one another by a gradual transition, so that an absolute line of separation is not always possible; a circumstance that does not invalidate the genuineness of their mutual contrast.

The exercise of Thought is greatly mixed up with Volition also, but there is rarely any difficulty in distinguishing the two functions. Indeed, it is hardly possible for us to exist in one exclusive state. Still, in our explanations of things, we often require to separate in statement what is not separated in fact.

4. If we advert to the various classifications of the mental phenomena that have hitherto passed current, we shall find that the three attributes above specified have been more or less distinctly recognized.

In the old division of mind into *Understanding* and *Will*, the element of Feeling would appear to be left out entirely. We shall find in fact, however, that the feelings are implied in, or placed under, both heads. The same remark applies to Reid's classification, also twofold and substantially identical with the foregoing, namely, into *Intellectual Powers* and *Active Powers*. The submerged department of Feeling will be found partly mixed up with the Intellectual Powers, wherein are included the Senses and the Emotions of Taste, and partly treated of among the Active Powers, which comprise the exposition of the benevolent and the malevolent Affections.

Dr. Thomas Brown, displeased with the mode of applying the term 'Active' in the above division, went into the other extreme, and brought forward a classification where Feeling seems entirely to overlie the region of Volition. He divides mental states into *External affections* and *Internal affections*. By external affections he means the feelings we have by the Senses, in other words, Sensation. The internal affections he subdivides into *Intellectual states of mind* and *Emotions.* His division therefore is tantamount to Sensation, Emotion, and Intellect. All the phenomena commonly recognized as of an active or volitional character, he classes as a part of Emotion.

Sir William Hamilton, in remarking on the arrangement followed in the writings of Dugald Stewart, states his own view as follows :—'If we take the Mental to the exclusion of Material phenomena, that is, the phenomena manifested through the medium of Self-consciousness or Reflection, they naturally divide themselves into three categories or primary genera ;—the phenomena of *Knowledge* or *Cognition,*—the phenomena of *Feeling* or of *Pleasure and Pain,*—and the phenomena of *Conation* or of *Will and Desire.** Intelligence, Feeling, and Will, are thus distinctively set forth.

I may farther notice the mode of laying out the subject that has occurred to an able physiologist. I quote a passage intended as introductory to the Anatomy of the Nervous System.

'Of the functions performed through the agency of the nervous system, some are entirely corporeal, whilst others involve phenomena of a mental or psychical nature. In the latter and higher class of such functions are first to be reckoned those purely *intellectual operations*, carried on through the instrumentality of the brain, which do not immediately arise from an external stimulus, and do not manifest themselves in outward acts. To the same class also belong *sensation* and *volition.* In the exercise of sensation, the mind becomes conscious, through the medium of the brain, of impressions conducted or propagated to that organ along the nerves from distant parts ; and in voluntary motion, a stimulus to action arises in the brain, and is carried outwards by the nerves from the central organ to the voluntary muscles. Lastly, *emotion*, which gives rise to gestures and movements, varying with the different mental affections which they express, is an involuntary state of the mind, connected with some part of the brain, and influencing the muscles through the medium of the nerves.'†

* Collected Works of Dugald Stewart, Vol. II.: Advertisement by the Editor.

† Dr. Sharpey, in QUAIN'S *Anatomy*, 6th edition, p. clxviii.

In this passage a quadruple partition is indicated,—Sensation, Intellect, Emotion, and Volition. Sensation is raised to the rank of a primary division. Except, however, as regards one important point to be afterwards adverted to, there is nothing in Sensation that does not come either under Feeling, as above defined, or under Intellect.

5. In the plan of the present volume, Part first, entitled 'Movement, Sense, and Instinct,' will include the discussion of both Feeling and Volition in their lower forms, that is, apart from Intellect, or so as to involve Intellect in the least possible degree; the Sensations of the different Senses will form a leading portion of the contents. This division will comprise all that is primitive or instinctive in the susceptibilities and impulses of the mental organization. The second Part will aim at a full exposition of the Intellectual properties.

Thus, while Feeling, Volition, and Intellect are regarded as the ultimate properties and the fundamental classification of mind, it is not proposed that the exposition should proceed strictly in the order thus stated.

Although Feeling and Volition, in their elementary aspect, can be explained before entering on the consideration of the Intellect, while one large important department of Feeling, namely, Sensation, is always considered as introductory to the Intellectual powers, yet the full exposition of the Emotions and the Active impulses of our nature properly comes last in the systematic arrangement of the mind.

6. It is requisite at the outset to give some intimation of a great mental law involved in the fundamental property of Discrimination above noticed, namely, the law of RELATIVITY. By this is meant that, as change of impression is an indispensable condition of our being conscious, or of being mentally alive either to feeling or to thought, every mental experience is necessarily *twofold*. We can neither feel nor know heat, except in the transition from cold. In every feeling there are two contrasting states; in every act of knowing, two things are known together.

With reference to many of our feelings, mankind have always to some extent recognized the working of this principle. It is seen that the first shock of the transition from one state to another—from sickness to health, poverty to abundance, ignorance to knowledge—is the most intense, and that as the memory of the previous condition fades away, so does the liveliness of the emotion caused by the change. Leisure, retirement, rest, are enjoyed only by contrast to previous toils. The incessant demands for novelty and change, for constant advances in wealth, in knowledge, in the arrangements of society, farther show the principle of Relativity as applied to pleasure.

Language contains many names avowedly relative, as parent, child; ruler, subject; up, down; north, south; light, dark; virtue, vice. It is obvious that either name in those couples implies the other; there can be no ruler without a subject. But, in reality, the principle of Relativity applies to everything that we are capable of knowing. Whatever we can conceive implies some other thing or things also conceivable, the contrast, co-relative, or negative of that. Red means the exclusion of all the other colours. If we had never been affected by any colour except red, colour would never have been recognized by us. When we speak of a fixed star, we mean to exclude certain other things—the sun, planets, comets, &c. When we make an affirmation, 'the stars shine by their own light,' we also by implication make a denial, 'the stars do not borrow their light.'

The applications of this principle are numerous and important. It bears directly on the arts of human happiness; it is essentially involved in Fine Art; it must be attended to in the communication of knowledge; in Metaphysics it conflicts with the doctrine of the Absolute. (For farther remarks on the Definition and Divisions of Mind, see APPENDIX A.)

CHAPTER II.

THE NERVOUS SYSTEM.

1. ALTHOUGH Subject and Object (Mind and Matter) are the most diametrically opposite facts of our experience, yet there is a concomitance or connexion between mind and a material organism. This position is best supported by the subsequent details. (See also APPENDIX B.)

The parts of the human frame that chiefly concern the student of mental science are the Nerves and Nerve Centres (principally collected in the Brain), the Organs of Sense, and the Muscular System. The organs of sense and of movement will be described afterwards; a brief description of the Nerves and Nerve Centres will occupy this preliminary chapter, in which we shall confine ourselves as far as possible to the facts bearing directly or indirectly upon Mind.

2. That the Brain is the principal organ of Mind is proved by such observations as the following:—

(1.) From the local feelings that we experience during mental excitement. In most cases of bodily irritation, we can assign the place or seat of the disturbance. We localize indigestion in the stomach, irritation of the lungs in the chest, toothache in the gums or jaws; and when the mental workings give rise to pain, we point to the head. In ordinary circumstances we have no local consciousness of mental action, but in a time of great mental agitation, or after any unusual exertion of thought, the aching or oppression in the head tells where the seat of action is, precisely as aching limbs prove what muscles have been exercised during a long day's march. The observation can occasionally be carried much farther; for it is found that a series of intense mental emotions, or an excessive strain on the powers of thinking, will end in a diseased alteration of the substance of the brain.

(2.) Injury or disease of the brain impairs in some way or other the powers of the mind. A blow on the head will destroy consciousness for the time; a severe hurt will cause a loss of memory. The various disorders of the brain, as inflammation, softening, &c., are known to affect the mental energies. Insanity is often accompanied by evident cerebral disease.

(3.) The products of nervous waste are increased when the mind is more than ordinarily exerted. The alkaline phosphates (triple phosphate of ammonia and magnesia) removed by the kidneys are derived principally from the waste of nervous substance; and they are sensibly increased after great mental exertion or excitement. Phosphorus abounds more in the brain than in any other tissue.

(4.) There is an indisputable connexion between size of brain and the mental energy displayed by the individual man or animal. It cannot be maintained that size is the sole circumstance that determines the amount of mental force. But just as largeness of muscle gives greater strength of body, as a general rule, so largeness of brain gives greater vigour of mental impulse. The measurements of the heads of remarkable men have often been quoted. 'All other circumstances being alike,' says Dr. Sharpey, 'the size of the brain appears to bear a general relation to the mental power of the individual,—although instances occur in which this rule is not applicable. The brain of Cuvier weighed upwards of 64 oz., and that of the late Dr. Abercrombie about 63 oz. avoirdupois. On the other hand, the brain in idiots is remarkably small. In three idiots, whose ages were sixteen, forty, and fifty years, Tiedemann found the weight of their respective brains to be 19¾ oz., 25¾ oz., and 22½ oz.; and Dr. Sims records the case of a female idiot twelve years old, whose brain weighed 27 oz. The weight of the human brain is taken at about 3 lbs. (48 oz.).'—QUAIN'S *Anatomy*, Vol. II., p. 432.*

* In a paper by Mr. John Marshall, of University College, read before the Royal Society (June, 1863), the author gives a minute account of

(5.) The specific experiments on the nerve cords and nerve centres, to be afterwards quoted, have proved the immediate dependence of sensation, intelligence, and volition on those parts.

No fact in our constitution can be considered more certain than this, that the brain is the chief organ of mind, and has mind for its principal function. As we descend in the animal scale, through Quadrupeds, Birds, Reptiles, Fishes, &c., the nervous system dwindles according to the decreasing measure of mental endowment.

three brains, one the brain of a Bushwoman, the others the brains of two idiots of European descent. The Bushwoman's brain was computed to have weighed in the fresh state $31\frac{1}{2}$ oz. One of the idiots was a woman aged forty-two years; she was able to walk, though badly, to nurse a doll, and to say a few words; the weight of her brain was 10 oz. 5 grs. The other was a boy of twelve; he could neither walk nor handle anything, nor articulate a single word; the weight of his brain was $8\frac{1}{2}$ oz. These are the two smallest idiot brains whose weight has been recorded.

Mr. Marshall enters into a very minute description of the structure of all the three brains, and his remarks are valuable as showing what other deficiencies, besides weight, attach to the brains of human beings of low mental power. Not merely is the cerebrum in idiots a small organ, having all the proper parts on a smaller scale, but these parts are fewer in number, less complex, and different in relative proportion and position. And in particular, the convolutions of the brain are much less developed, much simpler, than in an average brain. On comparing the two idiots in question, the convolutions of the woman were more developed than those of the boy.

The circumstance of inequality in the richness of the convolutions has been alluded to by physiologists as explaining the cases of great mental power allied with brains not above the average weight. Such differences have actually been observed in the examination of brains. The brain of Cuvier was said to be distinguished in this respect, as well as in weight. But the connexion of force of mind with richness of convolutions is also liable to various qualifications. It does not hold in the comparison of different species, —the sheep's brain is more highly convoluted than the dog's; and there are well authenticated cases of men of superior powers, whose brains, both as to weight and as to convolutions, were below the average. Still, there can be no doubt that generally, though not universally, an increase in one or both of these peculiarities is the concomitant of a higher mental endowment. Both the statistics of the Races of men, and Comparative Anatomy, are decisive to this extent.

We may readily suppose that, with a view to intellectual power, an abundance of nervous elements—fibres and corpuscles—must be accompanied with a felicitous distribution or arrangement of them.

3. 'The Nervous System consists of a *central part,* or rather a series of connected *central organs* named the *cerebro-spinal axis,* or *cerebro-spinal centre;* and of the *nerves,* which have the form of cords connected at one extremity with the cerebro-spinal centre, and extending from thence through the body to the muscles, sensible parts, and other organs placed under their control. The nerves form the medium of communication between these distant parts and the centre; one class of nervous fibres, termed *afferent* (incarrying) or *centripetal,* conducting impressions towards the centre,—another, the *efferent* (outcarrying) or *centrifugal,* carrying material stimuli from the centre to the moving organs. The nerves are, therefore, said to be internuncial in their office, whilst the central organ receives the impressions conducted to it by the one class of nerves, and imparts stimuli to the other, rendering certain of these impressions cognizable to the mind, and combining in due association, and towards a definite end, movements, whether voluntary or involuntary, of different and often of distant parts.'—Quain, Introduction.

The foregoing division of the nervous system into nerve-centres and nerve-cords determines the order and method of description both as regards their Anatomy, or structure, and their Physiology, or function.

THE NERVOUS SUBSTANCE.

4. 'The nervous system is made up of a substance proper and peculiar to it, with inclosing membranes, cellular tissue, and blood vessels. The *nervous substance* has long been distinguished into two kinds, obviously differing from each other in colour, and therefore named the *white,* and the *grey,* or *cineritious* (ash-coloured).

'When subjected to the microscope, the nervous substance is seen to consist of two different structural elements, viz., *fibres,* and *cells* or *vesicles.* The fibres are found universally in the nervous cords, and they also constitute the greater part of the nervous centres; the cells or vesicles, on the other hand, are confined in a great measure to the latter, and do not exist in the nerves properly so called, unless it be at their peripheral expansions in some of the organs of special sense; they are contained in the grey portion of the brain, spinal cord, and ganglia, which grey substance is, in fact, made up of these vesicles intermixed in many parts with fibres, and with a variable quantity of granular or amorphous matter.'

The nerve *fibres* are principally of the class termed *white*, or *tubular* nerve-fibres. They are of microscopic minuteness. In thickness, they range from the $\frac{1}{1500}$ to the $\frac{1}{12000}$ of an inch; the medium or average being $\frac{1}{6000}$ of an inch. When in the fresh condition, they are homogeneous and transparent, but after separation from the body they acquire a double outline or contour, and are apt also to assume a varicose or beaded appearance. The inference as to their ultimate structure, from these changes, is that each tube consists of (1) an outer structureless membrane, (2) an interior surrounding layer of transparent fatty matter, and (3) a central core or cylinder, which is not fatty, but albuminous in composition. The central band or axis appears alone, or divested of the two envelopes, both in the central connexions of the fibres, and in the ultimate ramifications in the extremities of the body; being, therefore, the essential part of the structure. In thickness, it does not exceed the $\frac{1}{100,000}$ of an inch.

These tubular nerve-fibres are finest on the superficial layers of the brain, and in the nerves of special sense; they are largest in the motor nerves. From the foregoing statements of their size, we may judge of the immense multiplication of the nervous elements. Estimates have been made of the number of fibres in individual nerves. The third cerebral nerve (the common motor of the eyes) is supposed to have as many as fifteen thousand fibres; the small root of the fifth (governing mastication) nine or ten thousand; the nerve of the tongue five thousand; these being all motor nerves, which have the largest fibres. It would be interesting to estimate the probable number of fibres of the nerve of sight, which, besides being a sensitive nerve, is much thicker than any of those just quoted; there cannot probably be less than one hundred thousand fibres, and there may be many more.

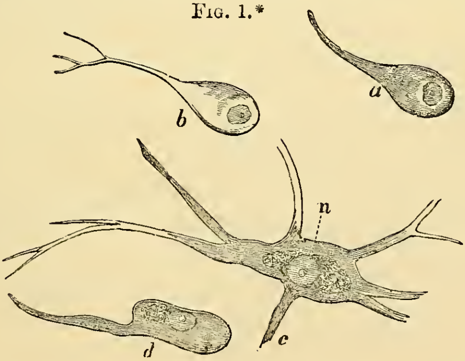
The number of nerve fibres forming the white substance of the brain must be counted by hundreds of millions.

In the grey substance of the nerve centres, the nerve fibres are supposed to be continuous with the cells or vesicles. At their other extremity in the organs of sense, in the muscles, and in the body generally, their mode of termination appears to be varied. Sometimes they end in loops, sometimes in meshes of network; not unfrequently sub-dividing into minuter nerves (besides dropping their two investing sheaths). In other cases, they seem, according to the majority of Anatomists, to end free in fine points, or else in little swellings of various structure.

It is important to note that each fibre is continued unbroken and independent from the central nervous masses to the peripheral extremity; there are no loose ends; and although the nervous cords frequently unite, as well as subdivide, in their course, the ultimate fibres are never fused with one another.

The nerve *cells*, vesicles, or ganglionic *corpuscles*, are little bodies, of a variety of forms; being round, oval, pear-shaped, tailed, and star-like or radiated. They consist of pulpy matter, with an eccentric roundish body or nucleus, enclosing one or more still smaller nuclei, surrounded by coloured granules. They vary in size from $\frac{1}{300}$ to $\frac{1}{3000}$ of an inch in diameter.

Fig. 1.*



* Nucleated nerve-corpuscles magnified 170 diameters. *a* and *b* from the cortical grey matter of the cerebellum; *c* and *d* from the spongy grey matter

When we take into account the amount of grey matter in the brain and spinal cord, which grey matter is made up of these bodies, mingled with fibres, the total number of corpuscles occurring in the nervous substance would have to be reckoned by millions.

With regard to the corpuscles existing in the grey matter of the convolutions of the brain, Dr. Lionel Beale gives the following conclusions as the result of his observations of the brain in man, in the sheep, the cat, and the dog :—

'1. The numerous nerve cells of the grey matter are all connected with, or give origin to, at least two fibres.

'2. These fibres, wide near their origin, gradually diminish in thickness till they are not more than $\frac{1}{100,000}$ of an inch in diameter.

'3. It is probable that the cells of the grey matter of the convolutions are connected together; but, in the adult, the cells are not often connected with those cells situated nearest them.

'4. There is no reason for supposing that the nerve cells, here or elsewhere, influence any nerve fibres save those that are *structurally continuous* with them.' (Proceedings of the Royal Society, Vol. XII., p. 673.)

Both the nerve fibres and the nerve cells or corpuscles are largely supplied with blood, a circumstance indicating great activity. The grey matter, which is constituted by the presence of the corpuscles, is usually spoken of as the seat of central nervous energy, and hence the grey masses are called the nervous centres. The supposition is, that these masses originate or re-inforce nervous power, which is then transmitted through the nerve fibres from one part of the system to the other. It is, however, shown by experiments that the nerve fibres themselves generate force; for the currents passing through them are augmented in their progress.

A second function of the corpuscles throws light on the plan and workings of the brain. They are the Grand Junctions, or Crossings, where the fibres communicate with one

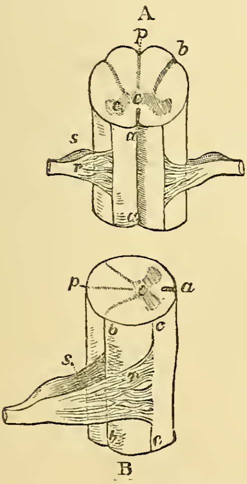
of the medulla oblongata; *n* the nucleus of a cell,—(*a*, *c*, and *d*, after Hannover). From QUAIN'S *Anatomy*.

another, and establish a vast system of lateral and forward connexions, necessary to the co-ordinating and concatenating of movements and sensations, in the bodily mechanism associated with mind. The fibres ascending through the spinal cord to the brain, pass into cells, some lower and others higher; new fibres proceed from these cells both laterally and onwards, and communicate with other cells and fibres in an exceedingly complicated arrangement. The spread and expansion of the white nervous substance, in the hemispheres of the brain, supposes, of necessity, that the fibres rising from below enter cells in the ganglia at the base of the brain, and that these cells send out in the upward direction a much greater number than what is received from beneath; and so on, till the multiplication attained in the hemispheres is reached.

THE NERVOUS CENTRES.

5. In the collective mass made up of the brain and spinal cord, and denominated the cerebro-spinal axis or centre, the following parts stand distinct from each other, although mutually connected by bundles of nerve fibres.

FIG. 2.*



I. The SPINAL CORD, contained in the back bone, and sending out two pairs of nerves from between every two vertebræ, one pair to each side of the body. The Cord consists of a column of white fibrous matter with a grey portion enclosed. In a cross section, the grey matter is seen to form two crescents, with the horns turned outwards, and connected in the middle of their convexities by a cross band.

* 'Plans in outline, showing the front, A, and the sides, B, of the spinal cord with the fissures upon it; also sections of the grey and white matter, and the roots of the spinal nerves. *a*, *a*, Anterior fissure. *p*, *p*, Posterior

II. The Encephalon or Brain. This includes the entire contents of the cavity of the skull, or cranium. The spinal cord is continued up into it. The brain is itself an aggregate of distinguishable masses of mixed grey and white matter. Each of these masses is looked upon either as a distinct centre, or as communicating between the centres. In proportion as the grey vesicular matter prevails, the mass has the characters of a centre and a grand junction; according as the white fibrous substance prevails, the part serves as a medium of conduction or communication solely. Of these various masses, some have a preponderance of grey, others of white matter. None are purely of one kind.

The mere mechanical arrangement of the brain is extremely complex, and there are different modes of classifying and grouping the various portions. The division adopted by human Anatomists is into four parts (a different arrangement has been proposed, founded on Comparative Anatomy). Those four parts are the *Cerebrum*, the *Cerebellum*, the *Pons Varolii*,

Fig. 3.*

fissure. *b*, Posterior, and *c*, Anterior horn of grey matter. *e*, Grey commissure. *r*, Anterior, and *s*, Posterior roots of a spinal nerve.'—Quain, Vol. II. p. 438.

* 'A plan in outline, showing, in a lateral view, the parts of the encephalon separated somewhat from each other. A, Cerebrum. *e*, Fissure of

and the *Medulla Oblongata.* 'The cerebrum, which is the highest and by far the largest part of the human encephalon, occupies the upper and larger portion of the cranial cavity.' 'The cerebellum is placed beneath the hinder part of the cerebrum, by which it is completely overlapped.' The pons Varolii is in the base of the brain near the entrance of the spinal cord, and connects together the three other parts,—the cerebrum, the cerebellum, and the medulla oblongata. The medulla oblongata connects the spinal cord with the brain.

6. In giving a more detailed description of those four parts, it will be convenient to take them in an inverse order, beginning from below, or where the brain joins the spinal cord.

(1.) The *Medulla Oblongata.*—This portion is continuous below with the spinal cord, of which it seems an expansion; lying wholly within the cranial cavity, its upper end passes into the pons Varolii. See Figs. 3 and 4, D.

'It is of a pyramidal form, having its broad extremity turned upwards, from which it tapers to its point of connexion with the spinal cord; it is expanded laterally at its upper part. Its length from the pons to the lower extremity of the pyramids is about an inch and a quarter; its greatest breadth is about three quarters of an inch; and its thickness from before backwards about half an inch.

In form and general anatomical characters, the medulla oblongata very much resembles the cord, of which it is a prolongation upwards to the brain. It is not our purpose here to enter into the minute anatomy of the part, or to set forth the points of difference between it and the cord; we need only observe that in it the white and grey constituents of the cord are both increased in size and altered in arrangement. The grey matter especially becomes more abundant, and additional deposits occur. The medulla oblongata has thus more of the character of an independent centre of nervous

Sylvius, which separates the anterior and middle lobes. B, Cerebellum. C, Pons Varolii. D, Medulla oblongata. *a*, Peduncles of cerebrum; *b*, Superior; *c*, Middle; and *d*, Inferior peduncles of cerebellum.'—QUAIN.

action, as well as of a grand junction, than belongs to the cord. It gives origin to nerves of a very special and important nature.

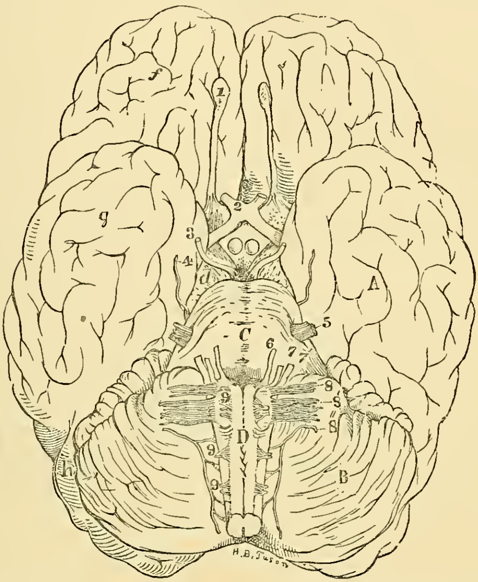
(2.) The *Pons Varolii,* or *annular protuberance* (tuber annulare). (See Figs. 3 and 4 C.) This 'is a comparatively small portion of the encephalon, which occupies a central position on its under surface, above and in front of the medulla oblongata, below and behind the crura cerebri *a*, and between the middle crura of the cerebellum *c*, with all which parts it is connected.' By the term 'crura cerebri,' introduced in this description, is meant the 'legs' or roots of the cerebrum, or the two bundles of nerves that unite it with the parts below. The crura of the cerebellum express in like manner the several connexions of that centre with the other centres. On account of the intermediate and connecting position of the pons, it has also been called the middle-brain (meso-cephalon). From its embracing, as in a ring, the medulla oblongata and stems of the cerebrum, it has derived the name of *annular* protuberance; the other name, 'pons,' or bridge, expresses the same circumstance.

'The substance of the pons Varolii consists of transverse and longitudinal white fibres, interspersed with a quantity of diffused grey matter. The transverse fibres, with a few exceptions, enter the cerebellum under the name of the middle crura or peduncles, and form a commissural (or connecting) system for its two hemispheres. The longitudinal fibres are those which ascend from the medulla oblongata into the crura cerebri, augmented, it would seem, by others which arise within the pons from the grey matter scattered through it.' The pons is thus mainly a grand junction between the medulla oblongata and spinal cord below, the cerebrum above, and the cerebellum behind. The existence of a considerable amount of the grey or vesicular matter proves that simple conduction or communication is not the sole function of this part of the brain.

(3.) 'The *cerebrum* or brain proper (Figs. 3 and 4, A), as already mentioned, is the highest, and by far the largest portion of the encephalon. It is of an ovoid (or egg) shape, but is regularly flattened on its under side. It is placed in the cranium with its small end forwards, its greatest width being opposite to the parietal eminences.

'The cerebrum consists of two lateral halves, or *hemispheres*, as they are called, which, though connected by a median portion of nervous substance, are separated in a great

FIG. 4.*



part of their extent by a fissure, named the great longitudinal fissure, which is seen on the upper surface of the brain, and partly also on its base.

'The cerebral hemispheres are not plain or uniform upon

* Shows the under surface or base of the encephalon freed from its membranes. A, Cerebrum. *f*, *g*, *h*, Its anterior, middle, and posterior lobes. B, Cerebellum. C, Pons Varolii. D, Medulla Oblongata. *d*, Peduncle of cerebrum. 1 to 9, indicate the several pairs of cerebral nerves, numbered according to the usual notation, viz.:—1, Olfactory nerve. 2, Optic. 3, Motor nerve of eye. 4, Pathetic. 5, Trifacial. 6, Abducent nerve of eye. 7, Auditory; and 7′, Facial. 8, Glosso-pharyngeal. 8′, Vagus. 8″, Spinal accessory nerve. 9, Lingual or hypoglossal nerve.

the surface, but are moulded into numerous smooth and tortuous eminences, named *convolutions,* or gyri, which are marked off from each other by deep furrows, called sulci, or *anfractuosities.* These convolutions are coloured externally; for the surface of the cerebral hemispheres, unlike the parts hitherto described, is composed of grey matter.'

The complete description of the cerebrum includes an account of the external surface with its convolutions, and of the various masses that make up the interior, and in part appear at the base of the brain. Although in the highest degree interesting as a study, no important application to our present subject arises out of such minute knowledge. There are, however, a few particulars that it is of use for us to add, selected out of the elaborate detail of cerebral Anatomy.

A distinction exists between the convoluted mass of the hemispheres and certain enclosed smaller masses of the cerebrum. Of these, there are two that are usually named together, partly on account of their proximity, and partly because it has not been practicable to distinguish completely their functions. They are the *optici thalami* and *corpora striata,* being double and symmetrical on the two sides. They both lie imbedded in the heart of the hemispheres. The peduncles or stems of the cerebrum pass into them before spreading out into the mass of the hemispheres. The third important mass is termed the *corpora quadrigemina* (quadruple bodies),* from consisting of four rounded masses put together in a square. This portion is more detached than the two others, and finds a place between the cerebrum and cerebellum. In some of the inferior animals it is very large, and takes a prominent position in the general structure of the brain; whereas the two other masses above mentioned for the most part rise and fall according to the degree of development of the convoluted hemispheres. Hence the comparative Anatomist assigns to the quadruple bodies a

* See in Fig. 3, the two rounded eminences behind *b*, the superior peduncle of the cerebellum. These represent the corpora quadrigemina in section.

character and function apart from the rest of the cerebrum. I quote a short description of each of the three centres.

The *corpora striata* 'are two large ovoid masses of grey matter, the greater part of which is imbedded in the middle of the white substance of the hemisphere of the brain.' 'The surface of the corpus striatum is composed of grey matter. At some depth from the surface white fibres may be seen cutting into it, which are prolonged from the corresponding cerebral peduncle, and give it the streaked appearance from which it has received its name.'

'The *thalami optici* (posterior ganglia of the brain) are of an oval shape, and rest on the corresponding cerebral crura, which they in a manner embrace. On the outer side each thalamus is bounded by the corpus striatum, and is then continuous with the white substance of the hemisphere.' 'The inner side of the two thalami are turned to each other.' 'The optic thalami are white on the surface, and consist of several layers of white fibres intermixed with grey matter.'

'In front of the cerebellum are certain eminences, which may be reached from the surface of the brain. These are the corpora quadrigemina, and above them is the pineal gland.'

('The pineal gland (conarium) so named from its shape (*pinus conus*, the fruit of the fir), is a small reddish body, which rests upon the anterior pair of the corpora quadrigemina.' 'It is about three lines (a quarter of an inch) in length, and its broad part, or base, is turned forwards, and is connected with the rest of the cerebrum by white substance.')

'The *corpora* or *tubercula quadrigemina* are four rounded eminences, separated by a crucial depression, placed two on each side of the middle line, one before the other. They are connected with the back of the optici thalami, and with the cerebral peduncles at either side.'

'The upper or anterior tubercles are somewhat larger and darker in colour than the posterior. In the adult, both pairs are solid, and are composed of white substance outside, containing grey matter within.

'They receive bands of white fibres from below.'—'A white cord also passes up on each side from the cerebellum to the corpora quadrigemina, and is continued onwards to the thalami:

these two white cords are the superior peduncles of the cerebellum. At each side, the corpora quadrigemina send off two white tracts, which pass to the thalami and to the commencements of the optic nerves.'

'In the human brain these quadrigeminal bodies are small in comparison with their size in the series of animals. In ruminant, soliped, and rodent animals, the anterior tubercles are much larger than the posterior, as may be seen in the sheep, horse, and rabbit. In the brains of carnivora, the posterior tubercles are rather the larger.'

'In the fœtus this part of the brain appears very early, and then forms a large proportion of the cerebral mass. The eminences are at first single on each side, and hollow. They are constant in the brains of all vertebrate animals, but in fishes, reptiles, and birds, they are only two in number, and hollow. In marsupialia and monotremata, they are also two in number, but solid.'

In this brief allusion to the different parts composing the cerebrum, we have had to exclude the mention of many smaller portions. We have also avoided all allusion to the *ventricles* of the brain. These are enclosed spades extending in various directions, and serving as boundaries to the other parts.*

(4.) 'The *cerebellum, little brain,* or *after brain* (Figs. 3 and 4, B), consists of a *body* and three pairs of *crura* or *peduncles,* by which it is connected with the rest of the encephalon. They are named superior, middle, and inferior peduncles.

* The following passage may assist in giving a connected view of the cerebrum, and also of the nature of the ventricular cavities or space.

'The hemispheres are connected together in the middle by the corpus callosum, and it is obvious that the structures filling up the interpeduncular space, serve also as connecting media. Between the corpus callosum above and the peduncles below, the two hemispheres are partially separated from each other, so as to leave an interval, *the general ventricular space,* across which some slighter connecting portions of nervous substance pass from one hemisphere to another.

'Again, as seen in a transverse vertical section of the cerebrum, the peduncles diverge as they ascend towards the hemispheres, and pass on each side through two large masses of grey matter, sometimes called ganglia of the brain,—at first through the thalamus opticus, and afterwards through a much larger mass named corpus striatum. These two masses of grey matter project

'The superior peduncles (Fig. 3, *b*) connect the cerebellum with the cerebrum through the corpora quadrigemina, as already stated. The inferior peduncles *d*, pass downward to the back part of the medulla oblongata. The middle peduncles, *c*, pass from the middle of the cerebellum around the outer side of the crura of the cerebrum, and meet in front of the pons Varolii, constituting its transverse fibres. They connect the two halves of the cerebellum below. All these peduncles consist of white fibres only; and they pass into the interior of the cerebellum at its fore part.'

'The *body* of the cerebellum B, being covered with cortical substance, is of a grey colour externally, but is rather darker on the surface than the cerebrum. Its greatest diameter is transverse: it is about three and a half or four inches wide, about two or two and a half from before backwards, and about two inches deep in the thickest part, but is much thinner all round its outer border.'

'It consists of two lateral *hemispheres*, joined together by a median portion called the *worm*, or vermiform process, which in birds, and in some animals still lower in the scale, is the only part existing.'

'The body of the cerebellum at the surface, and for some depth, consists of numerous nearly parallel laminæ or folia, which are composed of grey and white matter, and might be compared with the gyri or convolutions of the cerebrum, but are smaller and not convoluted. These are separated by sulci of different depths.'—QUAIN.

somewhat, as smooth convex eminences, on the upper and inner surface of the diverging fibres of the peduncles. Immediately above the thalami and corpora striata, the hemispheres are connected together across the median plane by the corpus callosum; and it is between the under surface of the latter, and the upper surface of the eminences mentioned and the interpeduncular structures, that the general ventricular space is situated in the interior of the cerebrum. The upper part of this space is again divided by a median vertical partition, so as to form the two *lateral* ventricles: below this, it forms a single cavity named the *third* or middle ventricle, which communicates with both the lateral ventricles above, and, below, with the ventricle of the cerebellum or *fourth* ventricle. The median vertical partition, which separates the lateral ventricles from each other, consists at one part (septum lucidum) of two layers, between which is contained the *fifth* and remaining ventricle of the brain.'—QUAIN.

7. We must next attend to the internal structure of the brain, considered as made up of the two kinds of matter, the grey and the white. The distribution and arrangement of those two kinds of matter throw light upon the mode of action, or the peculiar kind of activity that distinguishes the brain.

'*White Part of the Encephalon.*—The white matter of the encephalon consists of tubular fibres. The general direction which they follow is best seen in a brain that has been hardened by immersion in spirits, although it is true that we do not then trace the single fibres, but only the fine bundles and fibrous lamellæ which they form by their aggregation.'

'The fibres of the cerebrum, though exceedingly complicated in their arrangement, and forming many different collections, may be referred to three principal systems, according to the general course which they take, viz.—1. *Ascending or peduncular fibres*, which pass up from the medulla oblongata to the hemispheres, and constitute the two crura or peduncles of the cerebrum. They increase in number as they ascend through the pons, and still further in passing through the optic thalami and striated bodies, beyond which they spread in all directions into the hemispheres. These were named by Gall the *diverging* fibres. 2. *Transverse* or *commissural fibres*, which connect the two hemispheres together. 3. *Longitudinal* or *collateral fibres*, which, keeping on the same side of the middle line, connect more or less distant parts of the same hemisphere together.'

'*Grey Matter of the Encephalon.*—Considering the imputed physiological importance of the grey nervous substance, it may be well to mention connectedly the different positions in which it is found in the several parts of the encephalon.'

'By far the larger amount is situated upon the convoluted surface of the cerebrum and the laminated surface of the cerebellum, forming, in each case, the external cortical layer of cineritious matter.'

I omit a portion of the connected account of the spread of the grey matter in the parts in the interior and base of the brain, as including a number of terms that the reader has not been prepared for in the present sketch of the nervous system. We must rest satisfied with perusing, in addition to the above, the account of the distribution of grey substance in the larger portions, and in the parts already in some degree known to us.

'In the crura cerebri, the grey matter is collected into a dark mass; below this it is continuous with that of the pons and medulla oblongata, and through them with the spinal cord.' Thus, though the crura cerebri are, in the main, connexions of white matter between the hemispheres and the parts below, yet, like the medulla oblongata and spinal cord, they contain in the interior a portion of the grey matter, and are to that extent centres and junctions, as well as conductors.

'In the centre of each of the corpora quadrigemina, grey matter is also found, and it occurs in the pineal gland (and in the corpora geniculata). These last bodies appear to be appendages of the large masses of grey matter, situated in the interior of the cerebrum, named the optic thalami; which again are succeeded by the still larger collections of this substance, and indeed the largest situated within the brain,—viz., the corpora striata.'

8. *Plan of Structure indicated by the above arrangement of white and grey substance.*—It would appear, thus, that the cerebro-spinal centre, or the brain and spinal cord taken together, is an aggregate of distinct nervous masses or parts, each made up of a mixture of white and grey matter. The grey matter is the vesicular substance, consisting of cells or corpuscles; the white matter is the fibrous substance, being made up of fibres bundled together. The grey matter is a terminus; to it the fibrous collections tend, or from it commence. The fibrous matter contained within any of the cerebral masses is placed there as a means of communicating with some portion or other of the layers, or other collections, of grey substance.

Assuming that one class of nerve fibres (the sensory or incarrying)—those distributed to senses, viscera, &c.—are

employed in conveying influence from without inwards; and the other class (motory or outcarrying)—distributed to muscles, in conveying influence from within outwards,—we find that both classes are usually mixed together in the same ramifying branches, and in the common stem of white matter in the spinal cord. Let us imagine, however, the two kinds separated; the sensory nerves all emerging from the centres on one hand, and the motory nerves emerging apart on the other. We can then express the plan of the brain thus:—The sensory or incarrying fibres arising from the extremities enter the cord, proceed a certain way there, and begin to drop into corpuscles; from these corpuscles fresh fibres arise and proceed, some onwards and some laterally, to other cells; and so on. Thus, in the spinal cord, medulla oblongata, pons Varolii, &c.—up to the cerebral hemispheres, there is a repeated system of fibres passing into cells, and new fibres emerging, and going on to other cells; giving birth to an endless system of cross communications, like the railway network of England. Adverting now to the enormous connecting mass of fibres—ascending, diverging, and transverse—that make up the white substance of the brain, we must consider how the multiplication has been effected. There is only one conceivable process, when we consider that the entire mass is in communication, through cells, with the diminutive mass of the spinal cord. The process is this. For one fibre coming up from the sense organs and dropping into a cell, two, three, four, or more must emerge; each of these again, proceeding onwards to a new cell, and there replaced by three, four, &c., new fibres; and so on, until the expansion or multiplication is completed. Within the spinal cord, where there is no increase of bulk, the multiplying process is not begun; but in the upper course of the cord, where it enters the brain, there is an arithmetical necessity for the multiplication. We can hardly avoid the supposition that the *corpora striata* and the *thalami optici*, through which the great stem of the brain diffuses itself (by the ascending fibres) in the white matter of the hemispheres, are the principal seats of the multiplying corpuscles. For every fibre carrying impressions up from the senses, and every fibre carrying out stimulus to the moving organs, there must be perhaps ten thousand, perhaps a hundred thousand, traversing the brain, involving a great and rapid multiplication in the corpuscles of the grey substance.*

* It will be necessary, in speaking of certain functions closely allied to the mind, that some allusion be made to the portion of the nervous organization called the *Sympathetic System*, consisting of numerous *ganglia*, or little knots, together with *nerve cords*, and united by numerous nerve cords or branches to the cerebro-spinal system.

The sympathetic system consists of two knotted or ganglionated cords or strings, running, inside the trunk, from the neck to the pelvis, one on each side of the spine. The upper end is connected with groups of ganglia in the head and face; and, in the trunk, there are detached interlacements of ganglia, or *plexuses* having connexion with the great viscera in the chest and abdomen.

The knots, or Ganglia, are the centres or grey masses of the system, being made up of nerve corpuscles of a particular kind (having usually a single projection or tail). They exercise the usual functions of the corpuscles, in forwarding, diverting, reflecting, and concatenating nervous currents. The Cords are, as in the cerebro-spinal system, made up of nerve fibres, but these are of a peculiar sort, described as soft, granular, flattish (as opposed to tubular) fibres, without any surrounding sheaths or investments, and containing many dark nuclei; they are called the gelatinous, and the non-medullated fibres.

United with fibres from the cerebro-spinal system, these branches of the sympathetic are distributed over the whole body. Thus, as regards the head, they are found in the iris and the blood-vessels of the eye, in a muscle of the tympanum, in the nose, the palate, and the salivary glands. The great plexus of the chest (the cardiac) sends fibres to the heart, the great blood-vessels, and the lungs; from the aorta, nerves are continued to the arteries throughout the body. The abdominal plexus (called the solar plexus) supplies the stomach, intestines, liver, kidneys, and other abdominal viscera; each organ having a small plexus of its own. A still lower plexus contributes fibres to the parts contained in the pelvis. As all the ramifications contain a certain number of cerebro-spinal fibres, so it is believed that the cranial and spinal nerves contain everywhere some sympathetic fibres.

It is presumed from analogy, and from the functions exerted by the sympathetic system, that the fibres are of the two classes—incarrying and outcarrying. The incarrying nerves would receive stimulation from the peripheral surfaces; the outcarrying would convey motor stimuli to muscular fibres. This last function is the one most clearly manifested. The muscular fibres stimulated by the sympathetic nerves are almost all involuntary muscles, as the iris, the heart, the muscular coat of the blood-vessels, the

OF THE CEREBRO-SPINAL NERVES.

9. By the cerebro-spinal nerves are meant the connexions of the cerebro-spinal centre with the different parts of the body. These connexions consist of ramifications of nerve cords, threads, or bundles, arising in the central masses, and distributed like the blood-vessels, by subdividing and spreading themselves over the various organs and tissues, thereby establishing a connexion between the brain and the remotest extremities.

'These nerves are formed of the nerve fibres already described, collected together and bound up in membranous sheaths. A larger or smaller number of fibres inclosed in a tubular sheath form a small round cord, usually named a *funiculus;* if a nerve be very small, it may consist of but one such cord, but in larger nerves several funiculi are united together into one or more larger bundles, which, being wrapped up in a common membranous covering, constitute the nerve (Fig. 5). Accordingly, in dissecting a nerve, we first come to an outward covering, formed of cellular tissue,

intestines, &c. All these parts are primarily governed by the sympathetic system, with more or less interference from the cerebro-spinal centres, through the fibres intermingling with sympathetic fibres.

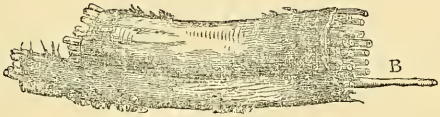
The sympathetic system presides over the viscera, which are the organs of the nutritive or vegetative life. It sustains the rhythmical action of the heart, and of the intestines. The fibres distributed to the small arteries everywhere maintain these vessels in a state of permanent contraction, the release from which, by extraneous influence, produces local congestion and the allied results. These fibres and their function, receive the designation *vasi-motor*.

The fibres of the sympathetic are not the medium of sensation. When pain arises in parts mainly supplied by them, as the intestines, it must be attributed to the irritation of the intermingled fibres of the cerebro-spinal class.

Many of the so-called *reflex* functions are due to the operation of the sympathetic nerves and ganglia. The extreme contrast to the proper voluntary actions is presented by the movements due to this system—witness the heart, the intestines, and the vasi-motor compression of the blood-vessels. Indeed, the absence of sensation and the absence of voluntary control are essentially the same fact.

but often so strong and dense, that it might well be called fibrous. From this common sheath we trace laminæ passing inwards, between the larger and smaller bundles of funiculi,

Fig. 5.*



and finally between the funiculi themselves, connecting them together as well as conducting and supporting the fine blood vessels which are distributed to the nerve.'

'The funiculi of a nerve are not all of one size, but all are sufficiently large to be readily seen with the naked eye, and easily dissected out from each other. In a nerve so dissected into its component fasciculi, it is seen that these do not run along the nerve as parallel insulated cords, but join together obliquely at short distances as they proceed in their course, the cords resulting from such union dividing in their further progress to form junctions again with collateral cords; so that, in fact, the funiculi composing a single nervous trunk have an arrangement with respect to each other similar to what we find to hold in a plexus formed by the branches of different nerves. It must be distinctly understood, however, that in these communications *the proper nerve fibres do not join together or coalesce.* They pass off from one nervous cord to enter another, with whose fibres they become intermixed, and part of them thus intermixed may again pass off to a third funiculus, or go through a series of funiculi and undergo still further intermixture. But through all these successive associations, the nerve fibres remain, as far as known, individually distinct, like interlaced threads in a rope.'

* 'Represents a nerve consisting of many smaller cords or funiculi, wrapped up in a common cellular sheath. A, the nerve. B, a single funiculus drawn out from the rest (after Sir C. Bell).'—Quain.

FUNCTIONS OF THE NERVOUS SYSTEM.

The Nerves.

10. The Nerves are divided into two classes, according as they proceed from the Spinal Cord, or issue direct from the brain. The first class, called the Spinal Nerves, is the most numerous. It is not implied that these nerves have no connexion with the brain, but merely that their place of emergence or 'superficial origin' is in the Spinal Cord. The arrangement is to be looked upon as a matter of local convenience. The nerves destined for the lower limbs do not leave the general trunk until they approach the neighbourhood that they are to supply; that is, they are prolonged within the spine to its lower extremity; whilst those branching towards the arms emerge in the neck and between the shoulders. On the other hand, the nerves that supply the face and head leave the brain at once by openings in the skull; these are the Cerebral Nerves. There is no difference of nature between the two classes.

In the mode of junction of the Spinal Nerves with the Spinal Cord, a peculiarity is observed of great importance in the present subject. I have already adverted to the fact that they issue from the spine in pairs, one pair between every two vertebræ; there are in all thirty-one couples. Each couple contains a right and a left member, for distribution to the right and left sides of the body. This part of the arrangement is likewise a matter of local convenience. But, further, when one individual of these emerging couples is examined, say a right branch, we find that this branch does not arise from the cord single; it springs from two roots, and these, after proceeding apart for a short way, unite in the one single nerve that is seen to issue from between the vertebræ on the right side. The same holds of any left branch that may be fixed upon; the connexion with the cord is not single, but double. The smaller of the two roots, in each case, proceeds from the fore part of the cord, and is called the *anterior* root;

the other or larger proceeds from the hinder portion of the cord, and is called the *posterior* root. This last root, the posterior, is distinguished in another point, besides its greater size. Just after leaving the cord, there is a ganglion or little swelling formed upon it, composed in part of grey matter, and being to appearance of the nature of a nerve centre. Beyond the ganglion, the two roots mingle and constitute the one nerve seen to emerge from the spine.*

11. Having thus noticed two classifications of the Nerves, the one—into Spinal and Cerebral—unimportant as respects function, the other—into Anterior and Posterior roots—highly important, as will be seen ; we now proceed to illustrate the precise function of a nerve. *The function of a nerve is to transmit impressions, influences, or stimuli, from one part of the system to another.*

The experimental proofs of this position are numerous, and they are now reckoned conclusive. If a main trunk nerve supplying a limb be cut through, all sensation in the limb ceases, and also all power of movement. The blood circulates and the parts are nourished, but, for the purposes of feeling or action, the member is excommunicated, dead. The telegraph wire is cut.

If, instead of cutting the nerve through, we prick or irritate it, we cause both feeling and movement. Whether the irritation is applied high or low, near the nervous centres or near the extremities of the body, the effect is the same. The pricking originates an impression or stimulus, which the nerve conveys through its whole length ; wherever that nerve ramifies, there is feeling or movement, or both. It appears, however that the influence *increases* as it passes along the nerve, presenting a marked contrast to the conduction of electricity by a wire, for the electric current diminishes by transmission. The nerve is not a passive, but an active conductor.

12. We have remarked of the nerves that they convey influence for the two distinct ends of causing action and of

* See Fig. 2, p. 17.

causing feeling. For Action, the influence must proceed *outwards* from the centres to the active organs; a stimulus from the brain or spinal cord has to be transmitted to the limbs, trunk, head, eyes, mouth, voice, or other parts that are to be set in motion. For Feeling, the influence must pass *inwards.* In a sensation of hearing, for example, an impression made on the sensitive surface of the ear is conveyed by the nerve of hearing towards the cerebral centres. Now, it is found that different sets of nerves are employed for these two purposes; one class being exclusively devoted to the outward transmission of stimulants to action or movement, while the other class is equally confined to the office of conveying influence centrewards, for the ends of sensation or feeling. The first of these two classes is that named *efferent* (outcarrying) nerves, the second comprises the *afferent* (incarrying) nerves. In the individual fibres, it would appear that the influence always follows one direction. No single nerve combines both functions.

It is further known, since the discoveries of Bell and others, that one of the two roots of the spinal nerves is entirely composed of nerves conveying the outward stimulus; these are, therefore, purely nerves of motion, *motor* nerves. The other root consists of fibres transmitting influence from the various parts of the body inwards to the centres; these are called the *sentient* nerves. (They are not all sentient in the full sense of the word, as will be afterwards explained.) The anterior roots are the motor nerves; the posterior roots are the incarrying or sentient nerves. On these last roots, the posterior, the ganglionic swellings occur; and, both in the spinal nerves and in those emerging at once from the brain by openings in the cranium, the occurrence of such a bead is a proof that the nerve is of the incarrying or sentient class.

In the experiments above described, as made upon trunk-nerves of an arm or leg, effects both of movement and of sensation were seen to follow; the limb was thrown into convulsive movements, and the animal showed all the symptoms of being in bodily pain. If, now, instead of a main trunk, the trial is made upon one of the roots of a spinal nerve, only a single effect will be produced,—motion without sensation, or sensation without motion of the part. If an anterior root is pricked or irritated, movements of some part of the body will follow, showing that an active stimulus has been discharged upon a certain number of muscles. If a posterior or ganglionic root is pricked, the animal will show symptoms of pain, and the pain will be mentally referred to the part where the filaments of the nerve are distributed. If the nerve is one proceeding to the leg, there will be a feeling of pain in the leg; but there will be no instantaneous convulsions and contractions of the limb, such as are produced by irritating an anterior root. All the movements that an animal makes under the stimulus of a sentient root, are consequent on the sensation of pain; they are not the direct result of the irritating application. In one of the trunk nerves of an arm or a leg, both motor and sentient fibres are mixed up, which is the reason of the mixed effect in the first experiment above mentioned.*

13. Experiments with pure nerves, that is, with motor fibres alone, or sentient fibres alone, are best made upon the nerves of the head,—the Cerebral Nerves. A certain number of these are exclusively motor, certain others are exclusively sentient, while a third kind are mixed, like the spinal nerves beyond the point of junction of the two roots.

The Cerebral Nerves are divided into nine pairs, some of these being considered as admitting of farther subdivision. *Four* are enumerated as nerves of pure sensation:—the nerve

* When an anterior root is cut through, irritation of the farther segment produces movements; irritation of the upper segment (nearest the brain) has no effect. If a posterior root is cut, irritation of the farther segment gives rise to no signs of sensation or of motion; irritation of the nearer segment causes signs of pain. The irritation of the farther segment of an anterior or motor root (whose result is movement) may, however, be accompanied with slight indications of pain; the explanation of which is, that the cramping or violent contraction of the muscles stimulates the sensory muscular fibres, which proceed to the brain by the undivided posterior, or proper sensory roots.

of Smell (olfactory nerve, 1st pair); the nerve of Sight (optic nerve, 2nd pair); the nerve of sensation of the Tongue and Face generally (5th pair)—(this nerve contains also a motor portion distributed to the muscles of mastication); the nerve of Hearing (auditory nerve, part of the 7th pair). These nerves, therefore, are engaged in transmitting influence from the surfaces of special sense, the nose, eyes, ears, tongue, and face, towards the cerebral mass. *Five* nerves are enumerated as purely motor or outcarrying:—the nerve supplying three of the four recti (or rectangularly arranged) and one of the oblique muscles of the eye, and sustaining its ordinary movements (*motor communis oculorum*, 3rd pair); the nerve supplying the superior oblique muscle of the eye (*trochlearis*, 4th pair); the nerve distributed to the external rectus muscle of the eye, and serving to abduct the two eyes by an independent stimulus requisite in adjusting the eyes to different distances (*abducent*, 6th pair); the trunk nerve for setting on the movements of the face and features (2nd part of 7th pair); the nerve for moving the tongue (9th pair). The pair reckoned the 8th has three divisions:—(1) the *glosso-pharyngeal* or sensory nerve of the tongue and throat; (2) the *vagus* or *pneumo-gastric*, the sensory nerve concerned in respiration, circulation, deglutition, and digestion; (3) the *spinal accessory* or motor nerve for regulating the movements of the parts supplied by the vagus—as the throat, larynx, and lungs.

If any one of the four sensitive nerves issuing from the cranium be cut through, sensation in the connected organ is lost; disease will produce the same effect. Injury in the optic nerve causes blindness, in the auditory nerve deafness. If any one of them is irritated by pricking, corrosion, or electricity, a sensation is produced of the kind proper to the nerve; if the olfactory nerve, there is a smell; the optic, a flash of light; the auditory, a sound; but no movement is generated. If any one of the five motor pairs is cut, the corresponding muscles cease to act; they are said to be paralyzed, an effect also produced by nervous disease. If the third pair were cut, the motion of the eyeballs would cease, there would no longer be any power of directing the gaze at pleasure; the most brilliant spectacle would fail to command the sweeping glances of the eye. If the moving portion of the 7th pair were cut on one side, all the muscles of the face on that side would lose their tension, and the equipoise of the two sides being thus destroyed, the face would be set awry, by the action of the unparalyzed muscles.

By experiments of this nature, the functions of the several cerebral nerves have been successively ascertained. In like manner, the discovery of the compound nature of the spinal nerves has been fully confirmed. It has been shown beyond the possibility of doubt, that the nerve fibres are of two distinct classes, with different functions, and that the same fibre never serves both functions.

Functions of the Spinal Cord and Medulla Oblongata.

14. With regard to the *Spinal Cord,* we find, in the first place, that it is necessary to sensation and to voluntary movement (movement from feeling) throughout the entire trunk and extremities of the body. If the cord is cut across at any part, all feeling is lost, and all power of movement by the will, everywhere below that place, or in every portion of the body where the nerves arising beyond the cut are distributed. If the division is made far down in the back, the lower limbs are the parts principally paralyzed; from them feeling comes no more, nor is it possible to move them by any mental effort. If the cut is in the neck, the paralysis overtakes the arms, trunk, and legs. It becomes evident, that the continuity of the cord with the brain is necessary in order to connect the mental system with the bodily members. The cord by itself will not give the power either of sensation or of voluntary movement. We must regard this portion of the cerebro-spinal axis as a main channel of nervous conveyance for sensation and for voluntary action, between the brain, and the trunk and the extremities of the body. The nerve ramifi-

cations are here, as it were, gathered together into one rope or bundle, for convenient transmission to and from the masses of the encephalon. To this extent the cord is the assemblage of the general mass of ramifying or communicating fibres; we may look upon it as the trunk of the tree, the final stream of the river system.*

If now we make experiments upon the cord when dissevered from the brain, we discover that a power of producing movements, though not voluntary, still remains. On irritating any portion of the substance, movements of the limbs are observed. This effect might, no doubt, arise from the continuity of the part with some of the motor nerves; for we have seen that movements in a limb are caused by pinching one of the nerves that supply the limb. But there is a mode of trying the experiment so as to prove decidedly that the spinal cord is itself a source of movement; that is, to prick the skin of the toes. When this is done, a convulsive stimulus instantly returns upon the limb and throws it into action. Hence we infer that an impression arising on the surface of the body and conveyed to the spinal cord, but not to the brain, causes the cord to send forth a motor stimulus to the moveable organs; a phenomenon, moreover, that ceases on the destruction of the cord.

'In most instances where the spinal cord has been divided, whether by design or accident, it has been found that al-

* Dr. Brown-Séquard has determined by decisive experiments that the transmission of sensitive impressions, in the spinal cord, takes place chiefly through the *grey* matter, and partly through the anterior columns; the impressions being conveyed to the grey matter by fibres passing obliquely across the posterior columns. The novel part of this doctrine is the attributing of a conducting function to the grey matter; although the grey substance of the cord contains white fibres, these are comparatively few in number, and the conclusion seems inevitable that a line of nervous communication is maintained by the corpuscles of the cord and their connecting fibres. The communication with the brain is maintained after cutting through the white columns, provided the grey substance remains intact; or if, although cut into at different places, it is nowhere completely severed. In the point of special function, there is much uncertainty as between the anterior and the posterior columns.

though the will cannot move the paralyzed parts, movements do occur in them of which the individual is unconscious, and which he is wholly unable to prevent. These take place sometimes as if spontaneously, at other times as the effect of the application of a stimulus to some surface supplied by spinal nerves. The apparently spontaneous movements frequently resemble voluntary actions so closely, that it is almost impossible to distinguish them.'

'The following experiments serve to illustrate these actions:—

'If a frog be pithed by dividing the spinal cord between the occipital hole and the first vertebra, an universal convulsion takes place while the knife is passing through the nervous centre. This, however, quickly subsides; and, if the animal be placed on the table, he will assume his ordinary position of rest. In some exceptional cases, however, frequent combined movements of the lower extremities will take place for a longer or shorter time after the operation; when all such disturbance has ceased, the animal remains perfectly quiet, and as if in repose, nor does there appear to be the slightest expression of pain or suffering. He is quite unable to move by any voluntary effort. However one may try to frighten him, he remains in the same place and posture. If now a toe be pinched, instantly the limb is drawn up, or he seems to push away the irritating agent, and then draws up the leg again into its old position. Sometimes a stimulus of this kind causes both limbs to be moved violently backwards. A similar movement follows stimulation of the anus. If the skin be pinched at any part, some neighbouring muscle or muscles will be thrown into action. Irritation of the anterior extremities will occasion movements in them: but it is worthy of note that these movements are seldom so energetic as those of the lower extremities.'—TODD and BOWMAN, I., 308-9.

These and other experiments prove, that to the cord belongs a power of originating movements, at the instance of stimulation applied to the surface or extremities of the body.

This function must be attributed to the grey matter, or to the mass of corpuscles enclosed in its substance. It is by the corpuscles that a stimulation can be reflected, diverted, or radiated into new channels. The movements prompted through the cord, by itself, may even be complex and rhythmical, as standing and walking, and locomotion generally; all which are possible to a certain extent, in many animals, after loss of communication with the brain.

The independent action of the spinal cord, in man, is shown in occasional acts of the reflex kind (to be afterwards fully enumerated). When the foot of any one asleep, or under chloroform, is tickled, the limb is withdrawn. In rupture of the spinal cord, irritation of the legs will induce movements, the patient being insensible to the effect.

There is one instance of muscular action by most physiologists ascribed to the spinal cord, and believed to have a peculiar interest in this point of view; that is, the *tension, tone*, or *tonicity* of the muscles. By this is meant the fact that a muscle is never wholly relaxed while the animal is alive. Even in the perfect repose of sleep, there is yet a certain vigour of contraction inhering in all the muscles of the body. The force of contraction is increased at the moment of wakening, and still more when an effort is to be made; but at no time is the relaxation total; the limbs never dangle like a loosely constructed doll, until after the animal is dead.

The experiments relied upon for showing that the permanent tension of the muscle is in part due to spinal influence, are very striking and not easily explained away. I quote from Dr. Carpenter: 'It has been proved by Dr. Marshall Hall that the muscular Tension is not dependent on the influence of the Brain but upon that of the Spinal Cord, as the following experiments demonstrate: Two Rabbits were taken: from one the head was removed; from the other also the head was removed, and the spinal marrow was cautiously destroyed with a sharp instrument: the limbs of the former retained a certain degree of firmness and elasticity; those of the second were perfectly lax.' Again: 'The limbs and tail of a decapitated turtle possessed a certain degree of firmness and tone, recoiled on being drawn from their position, and moved with energy on the application of a stimulus. On withdrawing the spinal marrow gently out of its canal, all these phenomena ceased. The limbs were no longer obedient to stimuli, and became perfectly flaccid, having lost all their resilience. The sphincter lost its circular form and contracted state, becoming lax, flaccid, and shapeless. The tail was flaccid.'—(Carpenter, p. 700.) Here we see that the disconnecting of the muscles from the brain still leaves them in a tense condition; whereas that tension gives way the instant the spinal cord is removed; whence we infer that there is an internal source of nervous energy, independent of stimulation from without, although greatly enhanced by the application of the stimulants of the senses. The importance of this fact will be afterwards seen.

15. The *Medulla Oblongata*, being a continuation of the spinal cord, with additional deposits of grey substance, has the same importance as respects the communication of impressions to and from the brain, but operates more widely in the way of diffusing, transferring, diverting, radiating, and reflecting nervous stimuli. Many of its corpuscles must have for their function the upward spread and ramification of fibres; while some serve for lateral communication, and others for the reflex function, which probably attains its highest development in this portion of the cerebro-spinal axis.

Most of the cerebral nerves arise from the medulla oblongata. It is the proximate centre of hearing and taste; of the sensibility of the face, the pharynx, larynx, windpipe, and bronchial tubes; and of the heart, lungs, and stomach.

Among reflex movements operated by means of it are—the contraction of the Pupil, and the closure of the Eye-lid, under the stimulus of light; the act of Deglutition; Sucking in the infant; and, lastly, the capital function of ordinary Respiration.

Functions of the lesser grey centres of the Brain.

16. These various masses lying between the medulla oblongata and the convoluted hemispheres, must be considered still as the continuation upward of the main stem of the brain, with multiplying, ramifying, and collateral communications through the aggregates of corpuscles in the grey portions of each. The paths of sensory impressions upwards, and of motor impressions downwards, must lie in these bodies, although the two lines are not always exhibited in marked local separation. There are also certain instances of the reflex function embodied in these centres.

The *Pons Varolii*, with the crura cerebri, is to be viewed in great part as a continuation of the spinal cord towards the brain, in which capacity it is essential to sensation and to volition. The paths of sensation are supposed to be through the fibres and grey substance of the central and posterior portions; the paths of voluntary motion, through the fibres of the anterior and under portions.

By means of the grey centres of the pons, there are manifested reflex acts of a marked and powerful kind. It shares in the regulation of the pupil of the eye. More remarkable is its mediation in the prominent movements of expression, as gesticulation and cries. It has also, in an eminent degree, the function of grouping or associating the movements; so long as it remains, the locomotive rhythm can be maintained, although, after the destruction of the hemispheres, there is no longer a spontaneous commencement of movements. While the pons, and all the centres beneath it, are intact, an animal will retain and secure the erect posture. Lastly, the removal of the parts above the pons does not take away the promptings to remedy uneasiness, and to remove irritating agents. This is the continuation of that exceptional function of the spinal cord, whereby, in the inferior animals, it can give birth to actions apparently of a voluntary character (see Note, p. 45).

It is in connexion with the pons that we have the most conspicuous manifestations of the curious fact of *rotatory* movement in animals, arising on injuries of parts of the brain. Thus, when the transverse fibres leading to the cerebellum are cut on one side, the animal revolves, as if on a spit, towards the injured side. Accompanying the rotation, there is a downward movement of the eye-ball on the injured side, and also rolling movements in the other eye. The effects are arrested by cutting the corresponding fibres leading to the other half of the cerebellum. In reality, the cerebellum may be considered the seat of the disturbance in the case now supposed; still the movements may also arise by a partial section of one of the cerebral crura or peduncles (in the heart of the pons), but they are in the opposite direction, that is, *away* from the injured side. A complete section of one peduncle causes the animal to fall on the opposite side, on which side the stimulus to the muscles survives.

These rotatory movements likewise follow from unilateral incisions, injuries, and diseases, in the corpora striata, thalami optici, corpora quadrigemina, cerebellum, medulla oblongata, and lastly, the auditory nerve, and the semicircular canals of the ear. The sensation of giddiness or vertigo corresponds to the same class of effects; a sensation known to be caused by whirling movements, even although voluntary, and by rapid visual movements, as well as by alcoholic stimulation and other cerebral derangements.

The hypothesis suggested by this singular manifestation is, that there exists, in permanence, a powerful nervous stimulation to the muscles of the two sides of the body, such as would cause an energetic propulsion of each. In the ordinary condition, the two sets of stimuli are balanced, and produce an equilibrium, disturbed only by the slight remissions necessary for locomotion and other voluntary exertions. The destruction of the nervous tracks or centres, on one half of the body, leaves a preponderance on the other; and the one-sided movements, that are seen in consequence, testify how energetic the persistent current must be. If this be the true interpretation of the phenomenon, we obtain from it a striking confirmation of the doctrine (to be afterwards adverted to) of internal or self-originated movements, as contrasted with the movements from outward stimulation.

17. The cerebral ganglion named the *Corpora Quadrigemina* is associated with the power of sight. Its destruction produces blindness, and also a permanent dilatation and immobility of the pupil of the eye. The destruction of one side causes loss of vision on the opposite side; but the irritation of one side will produce contraction of both pupils. The partial removal of the ganglion is attended with partial and temporary blindness, debility of the muscles on the opposite side of the body, and sometimes giddiness and slight rotatory movements. The anatomical connexions with the optic nerve also point to the conclusion, that the principal track of visual impressions to the brain is by the corpora quadrigemina.

18. Notwithstanding its name, the large ganglion called *Optic Thalami* has but little relationship to the sense of vision. Being in immediate connexion with the hemispheres, it is the final organ of multiplication or diffusion of fibres coming from below; and is supposed to consist chiefly of the sensory tracts. Like the other ganglia, it is inferred to contain fibres reflected downwards, as well as those diffused into the hemispheres. Experiments appear to show that it contributes to the function of co-ordinating movements, such as those of locomotion and emotional expression. Section on one side causes rotatory movements, usually towards the opposite side.

19. The other great ganglionic mass at the entrance to the hemispheres, the *Corpora Striata*, is believed to contain principally the motor fibres. We are to presume that the large amount of grey matter is chiefly concerned in multiplying the fibres entering into the hemispheres, but partly also in reflecting them downwards, so as to constitute circuits of reflex movements. The collective reflected fibres of all the ganglia at the base of the brain, together with the cerebellum,

are considered as making up a department or region, which is the seat of reflex acts, and of a large number of grouped or associated movements, involved alike in voluntary action and in emotional expression. It is not unlikely that consciousness accompanies the reflected, as well as the transmitted, currents of this whole region.

Functions of the Cerebral Hemispheres.

20. The *Convoluted Hemispheres* of the brain, in man and in the higher animals, are by far the largest mass of nervous substance, white and grey, and may be considered as associated with the most complicated of the mental functions, namely, those related to Intelligence.

Cutting or pricking the hemispheres is not attended with either sensation or movement. Pressure from above downwards, or concussion, produces stupor. When the hemispheres are removed, the following results are observed:—First, the two higher senses, Sight and Hearing, are lost. Secondly, Memory, and all the powers characteristic of intellect or thought, are abolished. Thirdly, Volition, in the shape of purpose and forethought, is extinguished.* This is involved in the loss of intelligence. An animal cannot proceed in the search for food, without ideas of what it wants, and a recollection of the means or instrumentality of procedure. Fourthly, there is still a power of accomplishing many connected movements. An animal may walk, swim, or fly, but there is no tendency to *begin* these actions. Fifthly,

* A lower kind of volition is possible in the absence of the hemispheres, as is shown by the experiments of Pflüger and others. A beheaded frog, whose hind foot is touched with an acid, makes efforts with the other hind foot to wipe away the acid. If a drop is placed on the back, on one side, the animal uses the leg on that side to relieve itself of the sting; but, if by cutting the nerve that leg is rendered powerless, the other leg is stimulated to remove the acid. These actions have the essential character of voluntary actions, and yet they proceed from no higher a centre than the spinal cord. They represent volition in one of its initial or undeveloped forms, the putting forth of action, to alleviate a *present* pain. The appearances would betoken that the pain is felt, or that the animal is conscious.

there remains an inferior form of the sensibility of the three lower senses—Touch, Taste, and Smell. By stimuli applied to these senses, reflex movements may be excited.

Thus, the hemispheres are not the exclusive seat of consciousness, but they are doubtless the seat both of Intelligence and of nearly all the innumerable shades and varieties of Sensation and Emotion.

The attempt to localize the mental functions in special portions of the cerebral mass, has been thwarted by observations of a remarkable kind. The phrenologists noticed cases where the destruction or disease of one hemisphere was unaccompanied with the entire loss of any function; the inference being that the hemispheres were duplicate bodies performing the same office, like the two eyes, or the two halves of the nostrils. But cases have been recorded of disease of large portions of the brain in both hemispheres at once, without apparent loss of function; which would require us to extend still farther the supposition of a plurality of nervous tracks for a single mental aptitude.

Functions of the Cerebellum.

21. The experiments made upon the *Cerebellum,* and the inferences founded upon its comparative size in different animals, have led some physiologists to assign to it the function of harmonizing and co-ordinating the locomotive and other movements.

'Flourens removed the cerebellum from pigeons by successive slices. During the removal of the superficial layers there appeared only a slight feebleness and want of harmony in the movements, without any expression of pain. On reaching the middle layers, an almost universal agitation was manifested, without any sign of convulsion; the animal performed rapid and ill-regulated movements; it could hear and see. After the removal of the deepest layers, the animal lost completely the power of standing, walking, leaping, or flying. The power had been injured by the previous mutilations, but now it was completely gone. When placed upon his back, he was unable to rise. He did not, however, remain *quiet* and *motionless*, as pigeons deprived of the *cerebral hemispheres* do; but evinced an incessant restlessness, and an inability to accomplish any regular or definite movement. He could see the instrument raised to threaten him with a blow, and would make a thousand contortions to avoid it, but did not escape. Volition and sensation remained—the power of executing movements remained; but that of co-ordinating these movements into regular and combined actions was lost.

'Animals deprived of the cerebellum are in a condition very similar to that of a drunken man, so far as relates to their power of locomotion. They are unable to produce that combination of action in different sets of muscles which is necessary to enable them to assume or maintain any attitudes. They cannot stand still for a moment, and in attempting to walk, their gait is unsteady, they totter from side to side, and their progress is interrupted by frequent falls. The fruitless attempts which they make to stand or walk are sufficient proof that a certain degree of intelligence remains, and that voluntary power continues to be enjoyed.' (TODD and BOWMAN, I., p. 359.)

When the cerebellum is cut away at the top, the animal moves backward. When one side is cut away, the animal rolls over to the other side; the eye of the sound side is turned outwards and downwards, the other eye inwards and upwards. Sometimes a vertiginous action ensues, as if the body were revolved on a spit.

The inference drawn from these experiments—that the cerebellum is the exclusive seat of combined movements—is denied by Dr. Brown-Séquard. He says—'I have ascertained that it is by the irritation they produce on the various parts of the base of the brain that the diseases of the cerebellum, or its extirpation in animals, cause the disorder of movements which has been considered as depending upon the absence of a guiding power. In fact, the least irritation of several parts of the brain with only the point of a needle, may generate very nearly the same disorder of movement that follows the extirpation of the cerebellum. I have thus been led to conclude that, after this extirpation, or after the destruction by disease of a large or small part of this nervous centre, it is not its *absence*, but some irritative influence upon the *parts of the encephalon that remain unaltered* which causes the irregularity of movements (Lectures, p. 79).

This line of criticism has the defect of proving too much; it would lead to the conclusion that the cerebellum has no function. The views of Flourens have been recently supported by M. Vulpian; who, after comparing numerous facts, has shown that, although disease or deficiency of the cerebellum is not uniformly attended with utter incapability of locomotion, yet there is a want of steadiness, and a great liability to stumble, in such instances. The safest inference at present seems to be, that the cerebellum is not the sole organ concerned in rhythmical or combined movements, but concurs with some of the other ganglia in upholding this function. The remark above made, regarding the plurality of nervous tracks for the higher cerebral aptitudes, may be extended to the inferior department of the combined or associated movements.

Of the Nerve Force, and the course of Power in the Brain.

22. The structure of the nervous substance, and the experiments made upon the nerves and nerve centres, establish beyond doubt certain peculiarities as belonging to the force that is exercised by the brain. This force is of a *current* nature; that is to say, a power generated at one part of the structure is conveyed along an intervening substance, and discharged at some other part. The different forms of Electricity and Magnetism have made us familiar with this sort of action. In a voltaic cell, energy is generated and transmitted along a wire with inconceivable rapidity to any place where the conductor reaches.

This portable, or current, character of the nerve force is what enables movements, distant from one another in the body, to be associated together under a common stimulus.

An impression of sound—a musical note, for example, is carried to the brain; the result is a responsive action and excitement extending to the voice, mouth, eyes, head, &c. This multiplex and various manifestation implies a system of connexion among the centres of action, whereby many strings can be touched from one point; a connexion due to the conducting nerves that pass and repass from centre to centre, and from the centres to the muscular apparatus over the body. Supposing the corpora quadrigemina to be a centre for the sense of vision, an impression passing to this centre propagates a movement towards many other centres,—to the convoluted hemispheres upwards, to the cerebellum behind, and to the medulla oblongata and spinal cord beneath; and through these various connexions an extensive wave of effects may be produced, ending in a complicated chain of movements all over the framework of the body. Such a system of intercommunication and transmission of power is therefore an essential part of the bodily and mental structure.

23. The experiments of Du Bois Reymond, show that there is a community of nature between the nerve force and common electricity. Electric currents are constantly maintained in the nerves and muscles, their character being changed during sensation and muscular contraction. The direction of these currents has been minutely examined by Du Bois Reymond, and he lays down a number of general principles regarding them. The following are some of his conclusions :—

'The muscles and nerves, including the brain and spinal cord, are endowed during life with an electro-motive power.'

'This electro-motive power acts according to a definite law, which is the same in the nerves and in the muscles, the law of the antagonism of the longitudinal and the transverse sections. The longitudinal surface is positive, and the transverse section negative.'

'Every minute particle of the nerves and the muscles must be supposed to act according to the same law as the whole nerve or muscle.' The total currents are, in fact, the combined effect of these currents circulating round the ultimate particles.

'The current in muscles when in the act of contraction, and in nerves when conveying motion, or sensation, undergoes a sudden and great negative variation of its intensity.' 'It has not been ascertained whether, in the act of contraction, the muscular current is only diminished, or wholly vanishes, or whether it changes its direction.'

Thus the proper nerve force—that is to say, the currents in the nerves during sensation and movement—is so far in unison with electricity, that it neutralizes and reverses genuine electrical currents proved to exist in the nerves and muscles in their condition of rest. This is the utmost that can be said in the present state of our knowledge. Even granting that the force conveyed along the nerves during the mental processes were identical with voltaic electricity, the character of the nerve substance would create some points of contrast between the phenomena of vital action and a common voltaic battery. The conducting power of nerve fibre is attended with nervous waste, and the substance has to be constantly renewed from the blood, which is largely supplied to the nerves, although perhaps not so largely as to the vesicles.

If now we compare this liability to waste and exhaustion with the undying endurance of an electric wire, we shall be struck with a very great contrast. The wire is doubtless a more compact, resisting, and sluggish mass; the conduction requires a certain energy of electric action to set it agoing, and in the course of a great distance becomes faint and dies away. The nerve, on the other hand, is stimulated by a slighter influence, and propagates that influence, with increase, by the consumption of its own material. The wire must be acted on at both ends, by the closure of the circuit, before acting as a conductor in any degree; the nerve takes fire from a slight stimulus like a train of gunpowder, and is wasted by the current that it propagates. If this view be correct, the influence conveyed is much more beholden to the conducting fibres, than electricity is to the copper wire. The fibres are made to sustain or increase the force at the cost of their own substance.

The nerve force is propagated more slowly than an electric current through a wire. The rate has been estimated at about 200 feet a second on an average. (It is to be remarked that a nerve is not a simple conductor, but is supposed to consist of a countless number of molecules, each of which has, playing round it, an electrical current, or currents, which are an obstacle to the simple or direct propagation.) There is always a certain delay in passing through the nerve centres; a reflex movement occupies from $\frac{1}{30}$ to $\frac{1}{10}$ of a second under favourable circumstances, which is more time than would be required for transmitting an influence through the same length of nerve without interruption. When the stimulus is weak, a proportionally longer time is required to produce the corresponding movement. We may suppose that what is called nervous excitement is a quicker rate of the nervous current.

24. It is now an admitted doctrine that the nervous power is generated from the action of the nutriment supplied to the body, and is therefore of the class of forces having a common origin, and capable of being mutually converted—including mechanical momentum, heat, electricity, magnetism, and chemical decomposition. The power that animates the human frame and keeps alive the currents of the brain, has its origin in the grand primal source of reviving power, the Sun; his influence exerted on vegetation builds up the structures whose destruction and decay within the animal system give forth all the energy concerned in maintaining the animal processes. What is called vitality is not a peculiar force, but a collocation of the forces of inorganic matter in such a way as to keep up a living structure. If our means of observation and measurement were perfect, we might render an account of all the nutriment consumed in any animal or human being; we might calculate the entire amount of energy evolved in the changes that make up this consumption, and allow one portion for animal heat, another for the processes of secretion, a third for the action of the heart, lungs, and intestines, a fourth for the muscular exertion made within the period, a

fifth for the activity of the brain, and so on till we had a strict balancing of receipt and expenditure. The nerve force that is derived from the waste of a given amount of food, is capable of being transmuted into any other form of animal life. Poured into the muscles during violent conscious effort, it increases their activity; passing to the alimentary canal, it aids in the force of digestion; at other points it is converted into sensible heat; while the same power is found capable of yielding true electrical currents. The evidence that establishes the common basis of mechanical and chemical force, heat, and electricity—namely, their mutual convertibility and common origin—establishes the nerve force as a member of the same group.

25. The current character of the nerve force, leads to a considerable departure from the ancient mode of viewing the position of the brain as the organ of mind. We have seen that the cerebrum is a mixed mass of grey and white matter,—the matter of centres and the matter of conduction. Both are required in any act of the brain known to us. The smallest cerebral operation includes the transmission of an influence from one centre to another centre, from a centre to an extremity, or the reverse. Hence we cannot separate the centres from their communicating branches; and if so, we cannot separate the centres from the other organs of the body that originate or receive the nerve stimulation. The organ of mind is not the brain by itself: it is the brain, nerves, muscles, organs of sense and viscera. When the brain is in action, there is some transmission of nerve power, and the organ that receives, or that originated, the power, is an essential part of the circle of mechanism.

The notion that the brain is a *sensorium*, or inner chamber, where impressions are accumulated, like pictures put away in a store, requires to be modified and corrected. The brain is highly retentive of the impressions made upon it; they are embodied in its structure, and are a part of its growth. They may be reproduced on after occasions, and then what we find is a series of currents and counter currents, much the same as what existed when the impression was first made. When the mind is in the exercise of its functions, the physical accompaniment is the passing and re-passing of innumerable streams of nervous influence. Whether under a sensation of something actual, or under an emotion or an idea, or a train of ideas, the general operation is still the same. It seems as if we might say, no currents, no mind. The transmission of influence along the nerve fibres from place to place, seems the very essence of cerebral action. This transmission, moreover, must not be confined within the limits of the brain : not only could no movements be kept up and no sensation received by the brain alone, but it is uncertain how far even thought, reminiscence, or the emotions of the past and absent, could be sustained without the more distant communications between the brain and the rest of the body —the organs of sense and of movement.

The more immediate source of nervous power is an abundant supply of blood. The arrest of the circulation in the brain, by stoppage of the heart, or by pressure on the head, is followed by loss of consciousness. On the other hand, excessive rapidity of the circulation quickens the thoughts and feelings, in other words, is productive of *excitement*, which may amount even to delirium. Again, as regards the *quality* of the blood, excess of carbonic acid, of urea, or of the other impurities removed by the excreting organs, depresses or destroys the mental function; the same effect arising from deficiency of nutritive material. And, obversely, abundance of nourishment, the full exercise of the purifying organs, and the presence of the agents known as stimulants, by affecting the quality of the blood, impart exhilaration and vigour to the mental functions.

MOVEMENT, SENSE, AND INSTINCT.

WE now commence the subject of MIND proper, or the enumeration and explanation of the states and varieties of Feeling, the modes of Action, and the powers of Intelligence, comprised in the mental nature of man.

In the First Book, which is to comprehend the MOVEMENTS, SENSATIONS, APPETITES, and INSTINCTS, I propose to deal with what may be termed the inferior region of mind, the inferiority being marked by the absence, in any great degree, of Intellect and cultivation. This is the region wherein man may be most extensively compared with the brute creation, whose intelligence and education are comparatively small. When the powers of a superior intellect, and the example and acquirements of former generations, are superadded to the primitive Sensations and Instincts, there results a higher class of combinations, more difficult to analyze and describe, and belonging therefore more properly to a later stage of the exposition.

It will, however, be remarked as a novelty in the plan thus announced, that the Appetites and Instincts have been included in the same department as the Sensations. In the works of former writers on Mental Science, as, for example, Reid, Stewart, Brown, and Mill, those portions of our nature have been included among the general group of ACTIVE POWERS, including Desire, Habit, and the Will. My reasons for departing from the example of these eminent writers are the following. In the first place, the Appetites and Instincts are scarcely at all connected with the higher operations of intelligence, and therefore they do not require to be preceded by the exposition of the Intellect; everything necessary to be said respecting them may be given as soon as the Sensations are discussed. In the second place, I hope to make it appear, that the illustration of the Intellectual processes will gain by the circumstance that Appetite and Instinct have been previously gone into. Thirdly, the connexion of Appetite with Sensation is of the closest kind. Fourthly, as regards Instinct, I conceive it to be proper to render an account of all that is primitive in our nature—all our untaught activities—before entering upon the process of acquisition as treated of under the Intellect. In addition to these reasons stated in advance, I trust to the impression produced by the effect of the arrangement itself, for the complete justification of my departure from the plan of my predecessors.

The division of the present Book will be into four chapters.

The subject of Chapter first is ACTION and MOVEMENT considered as spontaneous, together with the Feelings and Perceptions resulting from muscular activity.

Chapter second comprehends the SENSES and SENSATIONS.

Chapter third treats of the APPETITES.

Chapter fourth includes the INSTINCTS, or the untaught Movements, and also the primitive rudiments of Emotion and of Volition. These last subjects are necessary in order to complete the plan of the present Book, which professes to exhaust all the primitive germs, whether of Action or Feeling, belonging to our nature, before proceeding to the consideration of intelligence and acquisition. In the complete system of the mind, the Intellect is thus placed midway between the instinctive and the cultivated emotions and activities, being itself the instrument for converting the one class into the other.

CHAPTER I.

OF SPONTANEOUS ACTIVITY AND THE FEELINGS OF MOVEMENT.

1. THE feelings connected with the movements of the body or the action of the muscles, are now recognized as a distinct class, differing materially from the sensations of the five senses. They are often regarded as proceeding from a Sense apart, a sixth, or Muscular Sense, and have accordingly been enrolled under the general head of sensations. That they are to be dealt with as a class by themselves, no less than sounds or sights, love, irascibility, or the emotion of the ludicrous, is generally admitted.

With regard, however, to the position of this class of feelings in the plan or arrangement of our subject, there is still room for differences of opinion. In my judgment they ought not to be classed with the Sensations of the five Senses; and I believe further that the consideration of them should precede the exposition of the Senses. The reasons for this opinion are the two following:—namely, that movement precedes sensation, and is at the outset independent of any stimulus from without; and that action is a more intimate and inseparable property of our constitution than any of our sensations, and in fact enters as a component part into every one of the senses, giving them the character of compounds while itself is a simple and elementary property. These assertions require to be proved in detail, but before doing so, it is advisable to notice briefly the mechanism or anatomy of movement in the animal frame.

OF THE MUSCULAR SYSTEM.

2. *Muscular Tissue.*—'The muscular tissue is that by means of which the active movements of the body are produced. It con-

sists of fine fibres, which are for the most part collected into distinct organs, called muscles, and in this form it is familiarly known as the flesh of animals; these fibres are also disposed round the sides of cavities and between the coats of hollow viscera, forming strata of greater or less thickness. The muscular fibres are endowed with *contractility*—a remarkable and characteristic property, by virtue of which they shrink or contract more or less rapidly under the influence of certain causes which are capable of exciting or calling into play the property in question, and which are therefore named *stimuli*. A large class of muscles, comprehending those of locomotion, respiration, expression, and some others, are excited by the stimulus of the will, or volition, acting on them through the nerves; these are therefore named 'voluntary muscles,' although some of them habitually, and all occasionally, act also in obedience to other stimuli. There are other muscles or muscular fibres which are entirely withdrawn from the control of the will, such as those of the heart and intestinal canal, and these are accordingly named 'involuntary.' These two classes of muscles differ not only in the mode in which they are excited to act, but also to a certain extent in their anatomical characters.'—SHARPEY; QUAIN'S *Anatomy*.

Structure of Voluntary Muscles.—'The voluntary muscular fibres are for the most part gathered together into distinct masses, or muscles of various sizes and shapes, but most generally of an oblong form, and furnished with tendons at either extremity, by which they are fixed to the bones. The two attached extremities of a muscle are named, in anatomical descriptions, its origin and insertion,—the former term being usually applied to the attachment which is considered to be most fixed, although the rule cannot always be applied strictly. The fleshy part is named the belly.

'The muscular fibres are collected into packets or bundles of greater or less thickness, named fasciculi, or lacerti, and the fibres themselves consist of much finer threads visible by the aid of the microscope, which are termed muscular filaments, or fibrillæ.

'The fibres, although they differ somewhat in size individually, have the same average diameter in all the voluntary muscles, namely, about $\frac{1}{400}$ of an inch; and this holds good whether the muscles be coarse or fine in their obvious texture. According to Mr. Bowman their average size is somewhat greater in the male than in the female, being in the former $\frac{1}{352}$ and in the later $\frac{1}{454}$, or more than a fourth smaller.'—*Ib.*

'As to the structure of fibres, it has been ascertained that each is made up of a larger number of extremely fine filaments or fibrils, inclosed in a tubular sheath.' 'It would seem that the elementary particles of which the fibril is made up, are little masses of pellucid substance presenting a rectangular outline, and appearing dark in the centre.' 'The length of the elementary particles is estimated by Mr. Bowman at $\frac{1}{9400}$ of an inch. He finds that their size is remarkably uniform in mammalia, birds, reptiles, fishes, and insects.'—*Ib.*

Nerves of Voluntary Muscles.—'The nerves of a voluntary muscle are of considerable size. Their branches pass between the fasciculi, and repeatedly unite with each other in form of a plexus, which is for the most part confined to a small part of the muscle, or muscular division in which it lies. From one or more of such *primary* plexuses nervous twigs proceed and end by finer or *terminal* plexuses, formed by slender bundles consisting of two or three primitive tubules each, some of them separating into single tubules.—*Ib.*

'By means of the microscope these fine nervous bundles and single tubules may be observed to pass between the muscular fibres, and after a longer or shorter course, to return to the plexus. They cross the direction of the muscular fibres directly or obliquely, forming wide arches; and on their return they either rejoin the larger nervous bundles from which they set out, or enter into other divisions of the plexus. The nervous filaments, therefore, do not come to an end in the muscle, but form loops or strings among its fibres.'—*Ib.**

I refrain from entering into the description given of the involuntary muscles,—those of the heart, intestines, bronchial tubes, iris, middle coat of the arteries, &c.—as being less important for the object of the present work. It will, how-

* The active connexion between the nerves and the muscles would seem to consist in an electrical current passing from the one to the other. The numerous experiments of Du Bois Reymond and others in this subject, scarcely permit any other conclusion.

ever, be interesting to hear what the same authority has said on the Sensibility of muscle, and also on the Contractility, or the source of its power as a mechanical prime mover.

3. *Sensibility.*—'This property is manifested by the pain which is felt when a muscle is cut or lacerated, or otherwise violently injured, or when it is seized with spasm. Here, as in other instances, the sensibility, properly speaking, belongs to the nerves which are distributed through the tissue, and accordingly, when the nerves going to a muscle are cut, it forthwith becomes insensible. It is by means of this property, which is sometimes called the 'muscular sense,' that we become conscious of the existing state of the muscles which are subject to the will, or rather of the condition of the limbs and other parts which are moved through means of the voluntary muscles, and we are thereby guided in directing our voluntary movements towards the end in view. Accordingly, when the muscular sense is lost, while the power of motion remains,—a case which, though rare, sometimes occurs,—the person cannot direct the movements of the affected limbs without the guidance of the eye.'

On this passage I would remark that the two sensibilities described differ very much in their character. The sensibility to injuries is a fact distinct from those feelings of the state of voluntary muscles that serve to guide the movements in working for ends. The one is the passive, and the other the active, sensibility of muscle.

4. *Irritability or Contractility.*—'In order to cause contraction, the muscle must be excited by a stimulus. The stimulus may be applied immediately to the muscular tissue, as when the fibres are irritated by a sharp point; or it may be applied to the nerve or nerves which belong to the muscle; in the former case the stimulus is said to be "immediate," in the latter "remote." The nerve does not contract, but it has the property, when stimulated, of exciting contractions in the muscular fibres to which it is distributed, and this property, named the "vis nervosa" (true nervous force), is distinguished from contractility, which is confined to the muscle. Again, a stimulus may be either directly applied to the nerve of the muscle, as when that nerve is itself mechanically irritated or galvanized; or it may be first made to

act on certain other nerves, by which its influence is, so to speak, conducted in the first instance to the brain or spinal cord (or perhaps even to some subordinate nervous centre) and thence transferred or reflected to the muscular nerve.

'The stimuli to which muscles are obedient are of various kinds; those best ascertained are the following, viz.:—1. Mechanical irritation of almost any sort, under which head is to be included sudden extension of the muscular fibres. 2. Chemical stimuli, as by the application of salt or acrid substances. 3. Electrical; usually by means of a galvanic current made to pass through the muscular fibres, or along the nerve. 4. Sudden heat or cold. These four may be classed together as *physical stimuli*. Next, *mental stimuli*, viz.—1. The operation of the will, or volition. 2. Emotions, and some other involuntary states of the mind. Lastly, there still remain exciting causes of muscular motions in the economy which, although they may probably turn out to be physical, are as yet of doubtful nature, and these, until better known, may perhaps, without impropriety, be called organic stimuli; to this head may be also referred, at least provisionally, some of the stimuli which excite convulsions and other involuntary motions which occur in disease.'—p. clxxvii.

Of the stimuli thus enumerated the most interesting to us are the mental stimuli. These are described as of two kinds; the Emotions—or the influence of the Feelings—and the Will. A third kind is the Spontaneous force to be presently discussed. There is one other property of muscle, alluded to in the previous chapter, which is described as follows:—

5. *Tonicity or Tonic Contraction.*—'Although in muscles generally, contraction is succeeded by complete relaxation, there are various muscles which, after apparently ceasing to contract, remain in a state of tension, and have still a certain tendency to approximate their points of attachment, although this tendency is counterbalanced by antagonistic muscles, which are in the same condition, and the limb or other moveable part is thus maintained at rest. This condition of muscle is named "tonicity," or the "tonic state." It is no doubt a species of contraction, as well as the more conspicuous and powerful action with which it alternates; but it is employed merely to maintain equilibrium, not to cause motion, and it is not temporary but enduring—con-

tinuing during sleep when volition is in abeyance, and occasioning no fatigue. It appears to be excited through the medium of the nerves, though independently of the will, for when the nerves are cut it ceases, and then the muscles nearly become flaccid: the stimulus which acts on the nerves is not known.'

PROOFS OF SPONTANEOUS ACTIVITY.

6. We have now to consider the evidence that there is for the existence of a class of movements and actions, anterior to, and independent of, the sensations of the senses. This question, brought on here to settle a point of precedence or arrangement, has a far wider import, and will re-appear on various occasions in the course of the subsequent exposition.

The proofs principally relied on are the following:—

(1.) The already mentioned fact of the Tonicity of muscles. This fact I regard as proving the existence of a central stimulus in the nervous system. The tonicity does not, indeed, amount to actual movement; still, it is only a lower degree of the same thing: and what one centre does in a low degree, another may do in a higher; the peculiar mode of operation is established as a fact of the nervous mechanism.*

(2.) The permanent closure of certain of the muscles—those named sphincters—is an effect of the same nature as the tonicity, but displaying a more energetic stimulus still,

* Some physiologists would ascribe the tonicity, not to the exclusive influence of the centres, but to the existence of a constant stimulation proceeding from the extremities by the incarrying nerves. They allege in support of this view, that when all the sensory roots of the spine are cut, the tonicity disappears. This, however, would not affect the general doctrine in question. Granting that the muscular stimulus is in one sense reflex, and arises from a perennial irritation of the incarrying fibres, this constant irritation is not what we usually understand by stimulation from without. It is a current arising out of some constant condition of the sensitive tissues, and not out of visible and remitted applications to the parts. A constant stimulus is no stimulus at all. The real point is—given a certain intensity of outward stimulation, the resulting movements will vary according to the condition of the nerves and nerve centres; the same stimulus finding at one time a feeble, and at another time an energetic, response.

such as we can refer only to central influence. It cannot be referred to any impression from without. Neither can it be wholly ascribed to the muscle's own contractility, seeing that the destruction, or paralysis, of certain of the centres leads to the total relaxation of those muscles.

The singular rotatory movements, arising from uni-lateral section of the pons varolii and other ganglia, suggest, in a particularly marked manner, the existence of a high permanent charge of nervous power, ordinarily disguised by being in a state of equilibrium.

(3.) It is not altogether irrelevant, to cite the activity maintained by *involuntary* muscles, as showing the existence of a mode of power originating with the nerve centres. Nervous influence is required for maintaining the circulation of the blood, the movement of the food along the alimentary canal, &c., all which points to an inward evolution of force, although modified by stimulation in the several organs. It may be said that, when the movements are once commenced, the completion of one may be a stimulus to the succeeding; still the question would recur—by what force does the heart begin to beat?

Thus the notion of an initiative existing in the nerve centres is borne out by the tonicity, by the action of the sphincters, by the still more energetic movements of rotation, and by the analogy of the involuntary muscles. Seeing that the spinal cord and the other inferior ganglia are found capable of originating muscular contractions, we are entitled to suppose that the larger masses of the brain may be the sources of a much more abundant and conspicuous activity than these examples afford. The proofs that follow are intended to put in evidence the existence of such movements.

(4.) In wakening from sleep, movement precedes sensation. If light were essential to the movements concerned in vision, it would be impossible to open the eyes. The act of wakening from sleep can hardly be considered in any other view, than as the reviving of the activity by a rush of nervous power to the muscles, *followed* by the exposure of the senses to the influences of the outer world. The first symptom of awakening that presents itself is a general commotion of the frame, a number of spontaneous movements—the stretching of the limbs, the opening of the eyes, the expansion of the features—to all which succeeds the revival of the sensibility to outward things. Mysterious as the nature of sleep is in the present state of our knowledge, we are not precluded from remarking so notable a circumstance, as the priority of action to sensibility, at the moment of wakening.*

But if this be a fact, we seem to prove, beyond a doubt, that the renewed action must originate with the nerve centres themselves. The first gestures must be stimulated from within; afterwards, they are linked with the gestures and movements suggested by sense and revived by intelligence and will. The higher degree of permanent tension in the muscles when we are awake, is partly owing to the increased central force of the waking states, and partly to the stimulus of sensation. But in all cases, the share due to the centres must be considerable, although rendered difficult to estimate when mixed up with sensational stimulus. Thus the force that keeps the eye open throughout the day, is in a certain measure due to the spontaneous energy that opened it at the waking moment, for that force does not necessarily cease when the other force, the stimulus of light, commences.

We are at liberty to suppose that the nourished condition of the nerves and nerve centres, consequent on the night's repose, is the cause of that burst of spontaneous exertion at the moment of awakening. The antecedent of the activity is physical rather than mental; and this must be the case with spontaneous energy in general. When coupled with sen-

* This is maintained by Aristotle (Physica VIII. 2). He says that these wakening movements come, not from sense, but from an internal source. Some writers have taken the opposite view, but they have not, so far as I am aware, adduced any decided facts in support of that view. If we cannot establish an absolute priority of movement in the act of awakening, we may, at least, maintain that movement concurs with, and does not follow, the re-animation of the senses.

sation, the character of the activity is modified so as to render the spontaneity much less discernible.

(5.) The next proof is derived from the early movements of Infancy. These I look upon as in great part due to the spontaneous action of the centres. The mobility displayed in the first stage of infant existence is known to be very great; and it continues to be shown in an exuberant degree all through childhood and early youth. This mobility can be attributed only to one of three causes. It may arise from the stimulus of Sensation, that is, from the sights, sounds, contacts, temperature, &c., of outward things. It may, in the second place, be owing to Emotions, as love, fear, anger. Or, lastly, the cause may be Spontaneous energy.

The two first-named influences, external sensation and inward emotion, are undoubted causes of active gesticulation and movement. But the question is, Do they explain the whole activity of early infancy and childhood? I think not, and on evidence such as the following. We can easily observe when any one is under the influence of vivid sensation; we can tell whether a child is acted on by sights, or sounds, or tastes. And if the observation is carefully made, I believe it will be found, that although the gesticulations of infants are frequently excited by surrounding objects, there are times when such influence is very little felt, and when, nevertheless, the mobility of the frame is strongly manifested. With regard to inward feelings, or emotions, the proof is not so easy; but here, too, there is a certain character belonging to emotional movements, that serves to discriminate them when they occur. The movements, gestures, and cries of internal pain are well marked; so pleasurable feeling is distinguished by the equally characteristic flow of smiles and ecstatic utterance. If there be times of active gesticulation and exercise that show no connexion with the sights and sounds, or other influence of the outer world, and that have no peculiar emotional character of the pleasurable or painful kind, we can ascribe them to nothing but the mere abundance and exuberance of self-acting muscular and cerebral energy, which rises and falls with the vigour and nourishment of the general system.

The activity of young animals in general, and of animals remarkable for their active endowments (as the insect tribe), may be cited as strongly favouring the hypothesis of spontaneity. When the kitten plays with a worsted ball, we always attribute the overflowing fulness of moving energy to the creature's own inward stimulus, to which the ball merely serves for a pretext. So an active young hound, refreshed by sleep or kept in confinement, pants for being let loose, not because of anything that attracts his view or kindles up his ear, but because a rush of activity courses through his members, rendering him uneasy till the confined energy has found vent in a chase or a run. We are at no loss to distinguish this kind of activity from that awakened by sensation or emotion; and the distinction is recognized in the modes of interpreting the movements and feelings of animals. When a rider speaks of his horse as 'fresh,' he implies that the natural activity is undischarged, and pressing for vent; the excitement caused by mixing in a chase or in a battle, is a totally different thing from the spontaneous vehemence of a full-fed and underworked animal.

It is customary in like manner to attribute much of the activity of early human life, neither to sensation nor to emotion, but to 'freshness,' or the current of undischarged activity. There are moments when high health, natural vigour, and spontaneous outpouring, are the obvious antecedents of ebullient activity. The very necessity of bodily exercise felt by every one, and most of all by the young, is a proof of the existence of a fund of energy that comes round with the day and presses to be discharged. Doubtless, it may be said that this necessity may proceed from a state of the muscles, and not from the centres; that an uneasy craving rises periodically in the muscular tissue, and is transmitted as a stimulus to the centres, awakening a nervous current of activity in return. Even if this were true, it would not materially alter the case we are labouring to establish—namely, a tendency in the moving system to go into action, without any antecedent sensation from without or emotion from within, or without any stimulus extraneous to the moving apparatus itself. But we do not see any ground for excluding the agency of the centres, in the commencing stimulus of periodical active exercise. The same central energy that keeps up the muscular tonicity, must be allowed to share in the self-originating muscular activity. If so, the demand for exercise that comes round upon every actively constituted nature, is a strong confirmation of the view we are now engaged in maintaining.

Coupling together, therefore, the initial movements of infancy, the mobility of early years generally, the observations on young and active members of the brute creation, and the craving for exercise universally manifested, we have a large body of evidence in favour of the doctrine of spontaneous action.

(6.) The operation of what is termed Excitement likewise corroborates the position we are now maintaining. The physical fact of the excited condition is an increase in the quantity, or a change in the quality, of the blood in the brain. The mental fact is the increase of mental energy in all its modes. A stimulus applied, in such a condition, produces a more than usual response; and there is manifested an incontinent activity, irrespective of all stimulation. The outward movements are hurried and uncontrollable, the feelings are more intense, the thoughts are rapid; every mental exertion is heightened. When the excitement rises to the morbid pitch, as in disease, or under the influence of drugs, such as strychnine, there is an enormous expenditure of force, apart from any stimulation whatsoever: the altered nutrition of the brain is the sole influence concerned.

(7.) As a farther confirmation, it may be remarked that sensibility and activity do not rise and fall together; on the contrary, they often stand in an inverse proportion to each other. By comparing different characters, or the different states of the same individual, we may test the truth of this observation. The strong, restless, active temperament is not always marked as the most sensitive and emotional, but is very frequently seen to be the least affected by these influences. The activity that seems to sustain itself, costing the individual almost no effort, being his delight rather than his drudgery, and very little altered by the presence or the absence of stimulus or ends, is manifestly a constitutional self-prompting force; and such activity is a well known fact. It is one of the fundamental distinctions of character, both in individuals and in races; being seen in the restless adventurer, the indefatigable traveller, the devotee of business, the incessant meddler in affairs; in the man that hates repose and despises passive enjoyments. It is the pushing energy of Philip of Macedon and William the Conqueror. On the other hand, sensitive and emotional natures, which are to be found abundantly among men, and still more abundantly among women, are not active in a corresponding degree, while the kind of activity displayed by them, is plainly seen to result more from some stimulus or object, than from an innate exuberance of action. The activity prompted by ends, by something to be gained or avoided, is easily distinguished from the other by its being closely adapted to those ends, and by its ceasing when they have been accomplished. He that labours merely on the stimulus of reward, rests when he has acquired a competency, and is never confounded with the man whose life consists in giving vent to a naturally active temperament, or a superabundance of muscular and central energy.

(8.) Lastly, it will be afterwards shown, that without spontaneity, the growth of the Will is inexplicable.

Regions of Spontaneous Activity.

7. The muscles for the most part act in groups, being associated together by the organization of the nervous centres, for the performance of actions requiring concurrent movements.

The Locomotive Apparatus is perhaps the most conspicuous of the voluntary groups. This involves (taking vertebrate animals in general) the *limbs*—or the anterior and posterior extremities with their numerous muscles, and the *trunk* of the body, which in all animals chimes in more or less with the movements of the extremities. In the outbursts of spontaneous action, locomotive effort (walking, running, flying, swimming, &c.) is one of the foremost tendencies; having the advantage of occupying a large portion of the muscular system, and thus giving vent to a copious stream of accumulated power. No observant person can have failed to notice instances, where locomotion resulted from purely spontaneous effort. In the human subject, the locomotive members are long in being adapted to their proper use, and in the meantime they expend their activity in the dancing gestures and kicking movements, manifested by the infant in the arms of the nurse.

The locomotive action agitates the whole length of the spine up to the articulations of the neck and head. The members concerned, however, have many movements besides, especially in man; and these are found to arise no less readily. Thus the movements of the arms are extremely various, and all of them may burst out in the spontaneous way. The grasp of the hand is the result of an extensive muscular endowment, and at an early stage manifests itself in the round of the innate and chance movements.

The erections and bendings of the body are outlets for spontaneous activity, and especially erection, which implies the greater effort. When superfluous power cannot run into the more abundant opening of locomotive movement, it expends itself in stretching and erecting the body and limbs to the extreme point of tension. The erection extends to the carriage of the head and the distension of the eyes, mouth, and features.

The vocal organs are a distinct and notable group of the active members. The utterance of the voice is unequivocally owing on many occasions to mere profusion of central energy, although more liable than almost any other mode of action to be stimulated from without. In man the flow of words and song, in animals the outbursts of barking, braying, howling, are often manifestly owing to no other cause than the 'fresh' condition of the vocal organs.

The *eyes* have their independent centre of energy, whence results a spontaneously sustained gaze upon the outer world. When no object specially arrests the attention, the activity of the visual movements must be considered as mainly due to central power. In a person deprived of the sight of one eye, we find that eye still kept open, but not so wide as the other. The *mouth* is also subject to various movements which may often be the result of mere internal power, as is seen in the contortions indulged in after a period of immobility and restraint. The *jaws* find their use in masticating the food, but failing this, they may put forth their force in biting things put into the mouth, as in children not yet arrived at the age of chewing. The *tongue* is an organ of great natural activity, being endowed with many muscles, and having a wide scope of action. In the spontaneous action of the voice, which is at first an inarticulate howl, the play of the tongue, commencing of its own accord, gives the articulate character to utterance, and lays a foundation for the acquirement of speech.

Among the special aptitudes manifested among the lower animals we find marked examples of the spontaneity of action. The destructive weapons belonging to so many tribes, are frequently brought into play without any stimulus or provocation, and when no other reason can be rendered than the necessity for discharging an accumulation of inward energy. As the battery of the Torpedo becomes charged by the mere course of nutrition, and requires to be periodically relieved by being poured upon some object or other, so we may suppose that the jaws of the tiger, the fangs of the serpent, the spinning apparatus of the spider, require at intervals to have some objects to spend themselves upon. It is said that the constructiveness of the bee and the beaver incontinently manifests itself even when there is no end to be gained; a circumstance not at all singular, if we admit the spontaneous nature of many of the active endowments of men and animals.

The spontaneous activity is always observed to rise and fall with the vigour and state of nutrition of the general system, being abundant in states of high health, and deficient during sickness, hunger, and fatigue. Energetic movements, moreover, arise under the influence of drugs and stimulants acting on the nerves and nerve centres; also from fever and other ailments. Convulsions, spasms, and unnatural excitement, are diseased forms of the spontaneous discharge of the active energy of the nerve centres.*

OF THE MUSCULAR FEELINGS.

8. We are now brought to the express consideration of the first class of phenomena proper and peculiar to mind, namely, States of Feeling; these we have from the outset recognized as one of the three distinct manifestations of our mental nature. To give a systematic and precise account of the states of human consciousness,—a Natural History of the Feelings,—is one of the aims of the science of mind.†

* A critic of this work in the *National Review*, while admitting that the doctrine here contended for serves to explain phenomena that are left unexplained, on the assumption, most generally prevailing in the systems of the human mind, that our activity is called forth solely by the stimulus of our sensations—takes exception to the purely *physical* origin above assigned to the spontaneous movements. It is with the writer a serious ground of complaint that these movements are made to proceed from a "psychological nothing," or apart from any antecedent mental state. The question thus raised turns upon matter of fact, and if any observations can be produced to show that mind does manifest itself anterior to the spontaneous outburst, my statement is incorrect. But so far as I have been able to judge of what really happens, consciousness rapidly follows or else accompanies the spontaneous discharge, but does not precede it. We have unequivocal instances of movements arising without consciousness, as under chloroform and in delirium; and it is not contended that mind accompanies the movements of the fœtus in the womb. A disputed point substantially identical with this is handled at length in "The Emotions and the Will." (Emotions, chap. vii., sec. 12).

† It may facilitate the comprehension of the method herein adopted for the systematic delineation of the feelings, if I offer a few explanatory

9. There are three classes of Feelings connected with the moving organs :—

(1.) Feelings dependent on the *organic condition of the muscles;* as those arising from hurts, wounds, diseases, fatigue, rest, nutriment. Most of these affections the muscles have in common with the other tissues of the body ; and they will be considered under a subsequent head. Our plan requires that we should here exhibit the marked antithesis, or contrast, existing between Muscular Feeling proper (the Consciousnesss of movement, howsoever caused) and Sensation proper. The one is associated with energy passing outwards, the other with stimulation passing inwards ; the two facts mingle together in the stream of mental life, but are yet of a widely different nature.

remarks as to the scope of it. The reader is sufficiently acquainted with the threefold partition of mind into Feeling, Volition, and Intellect. If this partition be complete and exhaustive, every mental fact and phenomenon whatsoever falls under one or other of these heads; nothing mental can be stated but what is either a feeling, a volition, or a thought. It must, nevertheless, be observed, that mental states need not belong to one of these classes exclusively. A feeling may have a certain *volitional* aspect, together with its own proper characters: thus the mental state caused by intense cold is of the nature of a feeling in the proper acceptation of the term; we recognize it as a mode of consciousness of the painful kind, but inasmuch as it stimulates us to performing actions for abating, or freeing ourselves from, the pain, there attaches to it a volitional character also. In like manner, every state that can be reproduced afterwards as a recollection, or retained as an idea, has by that circumstance a certain *intellectual* character.

Now, in describing states that come properly under the general head of feeling, we are called upon to bring forward, in the first instance, the peculiarities, or descriptive marks, that characterize them as feelings. This done, we may carry on the delineation by adverting to their influence on activity, or volition; and, lastly, we may specify anything that is distinctive in the hold that they take of the intellect. It is clear that if a Natural History of the human feelings is at all possible, we must endeavour to attain an orderly style of procedure, such as naturalists in other departments have had recourse to. If the fundamental divisions of mind have any validity in them, they ought to serve as the basis of a proper descriptive method; in fact, the description should accord with them.

The plan, in its completeness, may be represented thus:—

PHYSICAL SIDE.

Bodily Origin. (For Sensations chiefly.)

Bodily Diffusion, expression, or embodiment.

(2.) Feelings connected with *muscular action*, including all the pleasures and pains of *exercise*. These are the states just alluded to as peculiar to the muscular system.

(3.) The Feelings that indicate the *various modes of tension of the moving organs*. According as a muscle is tense or relaxed, according as much or little energy is thrown into it, and according to the quickness or slowness of the contraction, we are differently affected, and this difference of sensibility enables us to judge of the positions of our active members, and of many important relations of external things. These are the feelings of muscle that enter most directly into our intelligence; having little of the character of mere Feeling, and a very large reference to Thought, they deserve a separate treatment.

MENTAL SIDE.
- Characters as *Feeling*.
  - Quality, *i.e.*, Pleasure, Pain, Indifference.
  - Degree.
    - As regards Intensity or acuteness.
    - As regards Quantity, mass, or volume.
  - Special characteristics.
- *Volitional* characters.
  - Mode of influencing the Will, or Motives to Action.
- *Intellectual* characters.
  - Susceptibility to Discrimination and to Agreement.
  - Degree of Retainability, that is, Ideal Persistence and Recoverability.

It is to be remarked that, as a general rule, pleasures agree in their physical expression, or embodiment, and also in their mode of operating on the will, namely, for their continuance, increase, or renewal. In like manner, pains have a common expression, and a common influence in promoting action for their removal, abatement, or avoidance. Hence the fact that a state is pleasurable or painful carries with it these two other facts as a matter of course.

Again, as regards the Intellect; Discrimination, Agreement, and Retainability are to a certain extent proportional to the *degree* of the feeling, or the strength of the impression. This being the case, the statement of the degree involves the probable nature of the properties connected with the Intellect. Hence it is unnecessary in most cases to carry the delineation through all the particulars of the table. It is only when a feeling possesses any peculiarities rendering it an exception to the general laws of coincidence now mentioned, that the full description is called for. Two or three examples of the complete detail will be given.

All throu h the present chapter, and through the following chapter on sensations, we shall require to keep in view this distinction between feelings that yield a large measure of the distinctive character of feeling, and others whose emotional character is feeble, and whose function it is to supply the materials of the intelligence. In the eye, for example, the effect of a blaze of sunshine is very different from the sight of a watch. The one serves for the purpose of immediate enjoyment, the other is nothing in itself, and derives its value from being remotely instrumental to our happiness. Among effects on the ear, the contrast between music and speech expresses the same distinction.

I. *Feelings of Muscular Exercise.*

These are feelings proper to the muscles. The mode of consciousness arising under muscular exertion cannot be produced in connexion with any other part of the system.

10. *Feeling of Muscular Exercise generally.* According to the manner of the exertion, the feelings differ considerably; a dead strain is different from movement; and distinct modes of consciousness attend quick and slow movements respectively. The most general and characteristic form of muscular exercise is exemplified in a dead strain, or else in great exertion with a moderate pace of movement.

11. To begin with the PHYSICAL side.

The physical state of a muscle under contraction may be inferred from the details already given. The particles making up the muscular threads are approximated by an energetic attraction developed in the muscle, under the stimulus supplied by the nerves. An intense physical force is produced by a peculiar expenditure of the substance of the muscular mass; and in the production of this force the tissue is affected, as it were, with a strong internal agitation. As the nerves supplied to the muscles are principally motor nerves, by which the muscular movements are stimulated from the brain and nerve centres, our safest assumption is, that the sensibility accompanying muscular movement coincides with the *outgoing* stream of nervous energy, and does not, as in the case of pure sensation, result from any influence passing inwards, by incarrying or sensitive nerves. It is known that sensitive filaments are distributed to the muscular tissue, along with the motor filaments; and it is reasonable to suppose that by means of them the *organic* states of the muscle affect the mind. It does not follow that the characteristic feeling of exerted force should arise by an inward transmission through the sensitive filaments; on the contrary, we are bound to presume that this is the concomitant of the outgoing current by which the muscles are stimulated to act. No other hypothesis so well represents the total opposition of nature between states of energy exerted, and states of passive stimulation.*

* I shall here present the views of some of the most distinguished physiologists upon this interesting question. I must premise, however, that none of them advert to the presumption arising from the great antithesis of movement and sensation, throughout the whole mental system. To them it would be a small matter, that the feelings of movement were ranked as merely another class of sensations, or as impressions passing to the brain by sensitive nerves. In my view, on the contrary, the most vital distinction within the sphere of mind, is bereft of all physiological support by such an hypothesis. I quote first from Dr. Brown-Séquard: 'J. W. Arnold has tried to show that the anterior roots of nerves contain the nerve fibres which convey to the sensorium the impressions that give the knowledge of the state of muscles,' as to degree of contraction or amount of movement. 'The chief fact on which he grounds his opinion is, that after section of the posterior roots of the posterior extremities of a frog, it can make use of its hind legs almost as well as if nothing had been done to the posterior roots.' It would appear, then, that not only the power of movement, but also the sense that guides the movements, is unconnected with the sensory nerves. 'This experiment is certainly of some value, and we must acknowledge that it is difficult to explain it otherwise than Arnold has done. Moreover, we have found that, after the section of *all* the posterior roots of the spinal nerves in frogs, the voluntary movements seem to be very nearly as perfect as if no operation had been performed, and that if the skin of the head is pinched on one side, the posterior limb on the same side tries to repel the cause of the pain, as well as if no injury had been made. I have also ascertained that in frogs rendered blind these experiments give the same result.'

But Arnold's hypothesis is not the only alternative. The supposition that the mind discriminates the degree of energy of the motor current, or the force

But the physical accompaniments of muscular exertion pass beyond the muscles themselves. We know that active exercise indirectly affects all the organs of the body. The circulation of the blood is quickened generally, and is made to flow by preference to the muscular tissue, the brain being

poured out from the brain in voluntary movement, is at least an equally admissible view. It would seem an unnecessary complication to have sensory nerves mixed up with the pure motor fibres; it would be to deny that the anterior roots are pure motor nerves. Dr. Brown-Séquard proceeds to remark :—'But although I agree so far with Arnold, I do not admit with him that it is only through the anterior roots that impressions are conveyed by the muscles to the brain. When a galvanic current is applied to the muscles of the limb of a frog, on which the posterior roots of the nerves of this limb have been divided, no trace of pain is produced, and all the other causes of pain are also unable to cause it when applied either to the skin or the muscles.' —(Lectures, p. 9.) This is in perfect accordance with the view that would assign the feelings of resistance and movements to the outgoing current by the motor nerves, and the sensibility to cramp and other pains, to the ingoing current by the sensory nerves.

E. H. Weber remarks :—'The discriminative sensibility of muscle seems, in many cases, owing to the presence, in muscle, of branches of the nerves of sensation going to the extremities, as we see in the distribution of twigs of the trigeminal nerves to the various muscles of the eye. This supply of sensitive nerves to the eye may be contrasted with the case of the diaphragm, a muscle under the influence of the will, yet less discriminative than the muscles of the eye, and scantily supplied with nerves of sensation. It would seem, nevertheless, that all does not depend on that; for, in many cases of complete and genuine anæsthesia (that is, loss of sensibility to pain), the power of voluntary motion in the senseless parts is still preserved.' This is a still more decided fact, inasmuch as the existence of insensibility to pain shows, that all the sensitive fibres are paralyzed, and yet the power of muscular guidance remains. This is consistent only with the supposition that the mind appreciates the motor influence as it proceeds from the brain to the muscles, without depending on a returning sensibility through the proper sensory fibres.

I quote next from Ludwig. 'Whether the nerves that subserve the muscular sense, and those that induce the muscular motion, are the same, is at present difficult to decide. It is conceivable, and not unlikely, that all knowledge and discrimination arrived at through the exertion of the voluntary muscles, are attained directly through the act of voluntary excitation; so that the effort of the will is at once proceeded on as a means of judgment. This opinion is supported by the fact, that the movements that give us mental judgments, in by far the greater number of cases, do not appear as muscular sensations; in other words, they are not, like the organic sensations of muscle, localized by us in the muscle and looked upon as possessing the in this way often relieved from a morbid excess of blood. The lungs are stimulated to increased action. The elimination of waste matter from the skin is promoted. There is a great increase of animal heat. Provided the waste of nutritive material caused by these various modes of increased

characters of a sensation.' Ludwig thus appeals to our consciousness as presenting the feeling of muscular energy in a characteristic form, and distinct from the feeling of muscular pains. And in this he seems to be right; for if consciousness be a safe guide in the matter, we should say that in the case of a voluntary effort, the feeling is as of power going out of us, and not as of a surface of sense stimulated by an external agent, and transmitting an impression inwards to the nerve centres.

The view that *organic* muscular pains are stimulated through the *sensory* fibres is strongly maintained by Ludwig. His reasons are:—First, Sensory fibres are distributed to the muscles along with the motor nerves. Secondly, the involuntary muscles, no less than the voluntary, are the seat of acute pains. Thirdly, the stimulation of the anterior roots does not produce pain. Fourthly, pains arising from long-continued action of the muscles exist for days after the cessation of the excitement of the motor nerves. This last phenomenon is explained by the chemical destruction of the muscular tissue, which has an irritating effect upon the sensory nerves existing in the muscles.

Finally, Wundt expresses himself as follows: 'Whether the sensations, accompanying the contraction of the muscles, arise in the nerve-fibres that transmit the motor impulse from the brain to the muscles, or whether special sensory fibres exist in the muscles, cannot be decisively settled. Certain facts, however, make the first assumption more probable. If special nerve-fibres existed, they must be connected with special central cells, and thus, in all probability, the central organs for the apprehension of these sensations would be different from those which send out the motor impulse; there would be two independent nerve-systems, the one centripetal, the other centrifugal. But in the one—the medium of the sensation—nothing else could be regarded as the stimulus than the changes taking place in the muscle, the contraction, or perhaps the electrical process in nerve and muscle accompanying the contraction. Now, this process is known to keep equal pace with the energy of the muscular contraction; and we must expect that the muscular sensation would constantly increase and decrease with the amount of internal or external work done by the muscle. But this is not the case, for the strength of the sensation is dependent only on the strength of the motive impulse, passing outwards from the centre, which sets on the innervation of the motive nerves.' This is proved by numerous cases of pathological disturbance of the muscular action in a limb. The patient can make a great muscular exertion, and have the corresponding sensation, *although the limb be hardly moved.* But, naturally, after long-repeated trial, this small movement becomes associated with the increased exertion.

action is duly supplied, the vital force of the system as a whole is raised by muscular exercise.

So much for the corporeal seat or Origin of the sensibility in question. There is still another physical aspect, namely, the Expression or Embodiment of the Feeling, which is not only the means of making known the state to others, but also an essential concomitant of its own existence.

By the very nature of the case, the feeling arising from great bodily exertion, is liable to be wanting in Expression, properly so called. The organs are so completely employed in the exercise itself, that they are not disposable as instruments of the expression of the feeling. The features of the face and the voice, which are by pre-eminence the organs of expression, are exerted chiefly in sympathy with the muscles engaged in the exercise. Hence, as regards outward embodiment, there is nothing to be remarked in connexion with muscular effort generally. It is only when the feeling happens to be pleasurable or the reverse, that any expression is shown, and such expression is merely the attendant of the pleasure or the pain as such.

12. We pass now to the MENTAL side. In reviewing the characteristics of the mental accompaniment of muscular action, viewed as *Feeling,* we will advert first to its Quality.

Observation shows that this is pleasurable, indifferent, or painful, according to the condition of the system. The first outburst of muscular vigour in a healthy frame, after rest and nourishment, is highly pleasurable. The intensity of the pleasure gradually subsides into indifference; and, if the exercise is prolonged beyond a certain time, pain ensues. In ordinary manual labour, there may be, at commencing in the morning and after meals, a certain amount of pleasure caused by the exercise, but it is probable that during the greater part of a workman's day, the feeling of exertion is in most cases indifferent. If we confine ourselves to the discharge of surplus energy in muscular exertion, there can be no doubt that this is a considerable source of pleasure in the average of human beings, and doubtless also in the animal tribes. The fact is shown in the love of exercise for its own sake, or apart from the ends of productive industry, and the preservation of health. In the case of active sports and amusements, there are additional sources of pleasurable excitement, but the delight in the mere bodily exertion would still be reckoned one ingredient in the mixture.

A part of the pleasure of exercise must be attributed to the increase of vital power generally; and the question arises, may not the whole be due to the augmented force of the circulation, respiration, &c.? It is certain that the rising to a higher condition as regards these important functions, is a source of pleasurable excitement. We may reasonably suppose, however, that the muscular system, which is the seat of so much unquestioned sensibility, should be capable of affording pleasure under favourable conditions. And I think our consciousness attests the same fact. The agreeable feeling in the exercise of the muscular organs, when the body is strong and fresh, can be localized, or referred to the muscles actually engaged. And it will be seen, as we proceed, that there are various facts connected with movement that are inexplicable, unless we suppose that the muscular tissue is of itself a seat of pleasurable, as it certainly is of painful, sensibility.

As to the Degree of this pleasure, we must of course pronounce it variable according to circumstances. But taking a common case, as that of an average healthy human being, going through each day the amount of bodily exercise that the system can afford, we should have to admit that this is an appreciable constituent of happiness. Doubtless by contriving such a combination of exercises as to bring all the powerful muscles into full play, the pleasure could be increased considerably above the ordinary experience in this respect. The pleasure is not what would be called acute, or of great intensity; its degree arises from the stimulation of a large mass of tissue.

A measure of the degree of our pleasures is found, not merely in comparing one with another in consciousness, but also in observing the pains that they are respectively able to subdue. In this particular case, however, there is a tendency to subdue pain, not through the evolution of pleasure merely, but through some of the direct physical consequences of muscular movement. The derivation of blood from the brain reduces the cerebral excitement, and with that the mental excitement, and so may operate in quenching painful irritation.

The third point in the description respects any Speciality in the case, serving still further to describe or characterize the feeling in question. Now, as regards muscular exertion, there is a notable speciality, a radical difference in kind, signified by such phrases as 'the sense of power,' 'the feeling of energy put forth,' 'the experience of force or resistance.' This is an ultimate phase of the human consciousness, and the most general and fundamental of all our conscious states. By this experience we body forth to ourselves a notion of resistance, force, or power, together with the great fact denominated an external world. In the sense of energy exerted, we are said to go out of self, or to constitute a something in vital contrast to all the rest of our mental experiences, a *not-me* as opposed to the *me* of passive sensibility and thought.

With regard to the *Volitional* peculiarities of the pleasure of muscular exercise there is not much to be remarked. As a pleasure it will work for its own perpetuation, increase, or renewal. According to the doctrine of spontaneous activity, the sense of pleasure would not be necessary for our passing into an active state in the first instance; but would simply operate to maintain the activity, and, by help of intelligent forethought, to keep the system in a high condition of fitness for the periodical effusion of energy.

The distinctively *Intellectual* properties of the muscular feelings will have to be referred to, as the sources of highly important perceptions. But before considering these, we should notice an intellectual aspect or property belonging to these feelings, in their strict character of feelings, or as pleasures and pains,—namely, the fact of their greater or less persistence in the memory, so as to constitute ideal pleasures or pains, and, in that capacity, to stimulate the will in pursuit or in avoidance. A pleasure may be very intense in the actual, but feeble in the ideal, or in the memory. Such a pleasure would not, in absence, prompt the will to energetic efforts for realizing it. Now, the pleasures of muscular exercise do not take a high place among persisting, remembered, or ideal pleasures; they are perhaps not at the bottom of the scale in this respect, but they are not much higher than the least intellectual of the sensations, as, for example, those of Digestion. But individuals differ in regard to this point; and in so far as active amusements and sports, and occupations largely involving muscular exercise, are a fixed object of passionate pursuit, for their own sakes, to that extent they must abide in thought, or possess intellectual persistence.

But the truly important intellectual aspect of muscular feeling is something quite different from any ideal pleasures and pains of exercise. It regards the discriminating and identifying of degrees and modes of the characteristic consciousness of expended energy; an experience corresponding with the great facts of the object world, named, resistance, force, power, velocity, space, time, &c. In these perceptions there is a neutrality as regards pleasure or pain.

We have already seen that, between the pleasure of exercise and the pain of fatigue, there is an intermediate state where there is still the characteristic feeling of energy expended. In this state, we usually cease to attend to the feeling, as feeling proper; we are rather occupied with the purely intellectual functions of discrimination and agreement; we think of the present expenditure as greater or less than some other expenditure, or as agreeing with some previously known instances. This is to be intellectually engrossed; and, under such an engrossment in the case of muscular exercise, we assume the *object* attitude; we are not self-conscious, but are engaged in knowing certain purely object facts called force, extension, &c.

Even if muscular exertion were attended with the pleasures of exercise or the pains of fatigue, yet if, from any circumstance, we were led to consider intently the degree or amount of the expenditure, as in aiming a blow at cricket, we should at that moment be entirely unconscious of the pleasure or pain of the situation ; the intellectual attitude (in this case the *object* attitude) is incompatible for the instant with the subject experience proper, of which pleasure and pain are characteristic modes. Even in the highest zest of muscular enjoyment, the feeling of pleasure is intermittent; it is eclipsed in the act of putting forth energy and of considering and comparing its amount; and re-appears at the end of the stroke, or during the suspense of our attention to the act itself. In this subtle transition, or contrast, is laid the groundwork of the great distinction of subject and object—mind and matter.

13. Having thus endeavoured to present a delineation of the first and simplest variety of muscular consciousness under exertion, we shall now cite a few examples of this form of the feeling.

The supporting of a weight on the back, head, or chest, or by the arms, is a common example of dead tension. The most interesting form of it is the support of the body's own weight, which yields a perpetual feeling of the muscular kind, varying with the attitudes. The feeling is least when we lie at full length in bed, and greatest in the erect posture. Sometimes the weight is oppresive to us, and gives the sensation of fatigue; in a more fresh condition of the muscles, it makes one item of our pleasurable consciousness. The fatigue of standing erect for a length of time is, perhaps, one of the commonest cases of muscular exhaustion. The pleasure of standing up after a lengthened repose gives an opposite feeling. When the bodily strength is great, the laying on of a burden is a new pleasure.

This case of great muscular tension, without movement, presents itself under a variety of forms, in the routine of mechanical operations, and in many other ways. In holding on as a drag, in offering or encountering resistance of any sort, in compressing, squeezing, clenching, wrestling, the situation is exemplified.

A certain amount of movement may be permitted without essentially departing from the case of dead tension, as in dragging a vehicle, and in efforts of slow traction generally.

14. When muscular tension brings about Movements, there must be a gradually increasing contraction, and not a mere expenditure of power at one fixed attitude. Each muscle has to pass through a course of contraction; beginning, it may be, at the extreme state of relaxation, and passing on, sometimes slowly, and at other times rapidly, to the most shortened and contracted condition. The sensibility developed during this process, is greater in degree, and even somewhat different in kind, from that now discussed. As a general rule, the feeling is more intense under movement, than under exertion without movement. The successive contraction of the muscle would seem capable of originating a more vivid stimulus than the fixed contraction. We even find that, in different degrees of rapidity, the character of the feeling changes, which requires us to make a division of movements into several kinds.

15. Let us first advert to what we may term, by comparison, *slow* movements. By these I understand such as a loitering, sauntering walk, an indolent style of doing things, a solemn gesture, a drawling speech, whatever is set down as leisurely, deliberate, dawdling. The emotion arising from this kind of movement is far greater than an equal effort of dead tension would produce. Indeed, we may say, that this is an extremely voluminous and copious state of feeling: being both abundant and strong, although deficient in the element that we recognize as the sense of energy, or of expended force; in fact, approaching more to the class of passive feelings. We may derive the greatest amount of pleasurable sensibility, at the least cost of exertion, through the means of well-concerted slow movements. In this case, it seems least unlikely that, together with the sense of expended energy, there is also present the proper sensibility of the muscular tissue, awakened

through the medium of the sensitive nerves. The resemblance of the state to the feeling of muscular repose, (which probably makes) an element in the voluminous sensation of approaching sleep, favours this view. The sense of expended energy is small, in fact almost wanting. But we must not overlook another circumstance, accounting for a copious sensibility under a small expenditure of force. When the energies of the system are strongly directed into the current of muscular activity, they are less available for the support of sensibility or feeling; the putting forth of energy in bodily movements is a diversion of the forces from the seats of passive sensibility, and is a well known remedy for too great mental excitement. Hence, obversely, the smallness of the active expenditure permits a larger manifestation of sensibility or feeling.

The relationship of the feeling in question to muscular repose and approaching sleep, is seen in the tendency of slow movements to induce those states. They are pre-eminently soothing in their nature, and when the system has contracted a morbid restlessness, they can gradually restore it to the healthy condition. After a bustling day, tranquillity is attained by the mere sympathy of measured movements, as music and the conversation of persons of sedate elocution. There is also a close intimacy between the feelings of slow movement and certain powerful emotions, as awe, solemnity, veneration, and others of the class of mingled tenderness and fear, entering into the religious sentiment. Accordingly, the funeral pace, the slow enunciation of devotional exercises, the solemn tones of organ music, are chosen as appropriate to the feelings that they accompany. All this still farther supports the position, that the feeling under consideration is not one of active energy, but the opposite. For all those sentiments are the response of man's powerlessness and dependence, and are developed according as the sense of his own energy is low.

16. There is every reason to believe that movements *gradually increasing or gradually diminishing*, are more pro-

ductive of pleasurable emotion than such as are of a uniform character. Indeed, a uniform movement is altogether of artificial acquirement. The natural swing of the limbs tends to get quicker and quicker up to the full stretch, and to die away again gradually. There would appear to be a special sensibility connected with the acceleration or steady diminution of movement. The gradual dying away of a motion is pleasurable and graceful in every sort of activity—in gesture, in the dance, in speech, in vision. The 'dying fall' in sound is an illustration of the same fact. It also goes to make the beauty of curved lines.

Possibly the effect may be explained on the great law of Relativity, or the necessity of change to our being mentally affected. A gradual acceleration or diminution of any agent that wakens sensibility is the surest antidote of monotony, in other words, the condition most favourable to consciousness.

17. We pass next to the consideration of *quick* movements. They differ considerably in feeling both from dead exertion and from slow motion. Although there may seem to be a common muscular sensibility at the bottom, the specific nature of it is greatly altered. One accompaniment of the quickness is the increased excitement of the nerves; an increase totally distinct from the addition of energy expended to heighten an effort of dead resistance. Mere rapidity of movement has a specific influence in exciting the nerves and nerve-centres to a greater spontaneous activity; in short, it belongs to the class of nervous stimulants. The stimulation would appear to be all the greater, when the organs are unresisted, and consequently demand little expenditure of energy. For inducing an unwonted degree of excitement generally, for inflaming the animal spirits, and bringing on various manifestations and exaggerated efforts, quick movement is an available instrumentality. We may compare it in this respect with acute pains (not severe enough to crush the energies). Rapid motions are a species of mechanical intoxication. Any one organ, however small, made to move quickly, imparts its pace to all the other

moving organs. In a rapid walk, still more in a run, the mental tone is excited, the gesticulations and the speech are quickened, the features betray an unusual tension.

Examples of this class of motions and feelings are sufficiently abundant. They are expressly sought to give hilarity and excitement to human life. The chase, the dance, the vehemence of oratory and gesture, the stirring spectacle, are prized for their stimulating character, as well as for their proper sensations. In the ecstatic worship of antiquity,—in the rites of Bacchus and Demeter,—a peculiar frenzy overtook the worshippers, yielding an enjoyment of the most intense and violent character, and in its expression mad and furious. This state is often brought on among the Orientals of the present day, and in a similar manner, namely, by rapid dancing and music under the infection of a multitude.

Movements, when too quick, excite the brain to the state of dizziness and fainting (see p. 43).

Thus, then, Dead Resistance is a source of pleasure in a healthy system, a derivative of morbid excitement from the brain, and the origin of our most general and fundamental sensibility, constituting the consciousness of the object, or external, world. Slow Movements are allied to the passive pleasures, and may affect us more through the sensitive, than through the motor nerves of the muscles. Quick Movements affect us less as movement, than as stimulating the nerves to increased action, the consequence being a higher mental tone for feeling, for volition, and for thought.

18. A remarkable feeling connected with movements, is that arising from the sudden *loss of support*, as when the footing, or any prop that we lean upon, suddenly gives way. The contraction of a muscle demands two fixed points of resistance at its extremities; if one of those breaks loose, the force of the contraction has nothing to spend itself upon, and a false position is incurred. The contraction suddenly freed from its resistance does not make a vehement convulsive collapse like a spring; it would appear rather that the contractive force ceases almost immediately; and the

sensation resulting is one of a most disagreeable kind. It would seem to result rather from the jar given to the nervous system than from any influence flowing out of the muscle. The whole frame is agitated with a most revulsive shock, the cold perspiration is felt all over, and a sickening feeling seizes the brain. The breaking down of any prop that we are resting on, the snapping of a rope, or the sinking of a foundation, exemplify the most intense form of the effect. We may probably look upon the peculiar influence whose repetition induces sea-sickness, as of the same nature. The sinking of the ship has exactly the same unhinging action in a milder degree, although when continued for a length of time, this produces a far worse disturbance than any single break-down, however sudden. The precise physiological action in this situation, does not seem agreed upon; the feeling is known to be one of the most distressing that human nature is subject to, being an intense and exaggerated form of stomachic sickness.*

19. We must next advert to what are called *passive* (but more properly *compelled)* movements. Riding in a vehicle is the commonest instance. One of the pleasures of human life is to be driven along at a moderate speed, in an easy carriage. Now, it may be supposed at first sight, that there ought to be no feeling of muscular exertion whatsoever in this case, seeing that the individual is moved by other force than his or her own. Under certain circumstances this would be strictly true. We have no feeling of our being moved round with the earth's rotation, or through space by the movement about the sun. So in a ship, we often lose all sense of being driven or carried along, and feel pretty much as if there were

* Sea-sickness is explained by some as the result of the excessive flow of blood to and from the head. When the ship makes a downward motion, the feeling of loss of support is accompanied by a rapid flow of blood to the brain, and, when the ship rises, as rapid a flow ensues in the opposite direction. It is asserted further, that the flow either way may be diminished, if an upward motion of the body be made at the time of the ship's downward motion, and a downward motion at the time of the ship's rising; and that sickness can in this way be prevented.

no forward movement at all. The sensibility arising in a carriage movement, is in part imbibed through the eye, which is regaled by the shifting scene, and partly through the irregularities of the movement, which demand a very gentle action of the muscles of the body in order to adapt it to those irregularities. By springs and cushions, all violence of shock is done away, while the easy exercise caused by the commencement and stoppages of the motion, by the slight risings and fallings of the road, is somewhat of the nature of that influence already described as arising from slow and gentle movements. Moreover, as has been observed by Dr. Arnott, the effect of the shaking is to quicken the circulation of the blood.

In horse exercise, there is a large amount of the ingredient of activity. The rider is saved a part of the exhaustion caused in walking, and has yet exercise enough for the stimulus of the bodily functions, and for muscular pleasures.

The rocking chair, introduced by the Americans, who seem specially attentive to the luxuries of muscular sensibility, is another mode of gaining pleasure from movement. Anciently, furniture was adapted for the pleasures of repose solely, but now the boy's rocking horse has its representative among the appurtenances of grown men.

On the whole, it is apparent that a large fraction of physical enjoyment flows out of the moving apparatus and muscular tissue of the body. By ingeniously varying the modes of it, this enjoyment is increased still farther. The pleasure comes incidentally to manual labour, when moderate in amount and alternated with due sustenance and repose, and is a great element of field sports and active diversions of every kind ; it is a part of the pleasures of locomotion ; and contributes the principal ingredient in gymnastic exercises and athletic displays.

II. *Of the Perceptions grounded in the Muscular Feelings.*

20. In alluding to the strictly Intellectual properties of the feeling of expended muscular energy, we had to advert to

that mode, neutral as regards pleasure and pain, whereby we are occupied with the properties of the object world, as resistance, force, &c.

This function of our muscular sensibility arises, in the first instance, from our being conscious of the different *degrees* of it. We have not only a certain feeling when we put forth muscular power, but we have a change of feeling when we raise or lower the amount of the power. If we hold a weight of four pounds in the hand, the consciousness is changed when another pound is added. This change of feeling is completely expressed by the word, Discrimination, and is the basis of our intelligence; as pleasure or pain, it is nothing, but as the commencement of knowledge, it is all-important.

The modes of muscular action that affect us by their differences of degree, appear to be three. The first is the amount of exertion, or of expended *force*, which measures the *resistance* to be encountered. This is the fundamental experience. The second respects the *continuance* of the exertion, and applies both to dead strain and to movement. The third is a mode of movement solely; it is the *rapidity* of the muscle's contraction, which corresponds with the velocity of movement in the organ. In distinguishing the qualities of external things, and in attaining permanent notions of the world, all these discriminations are brought into play.

21. First, with respect to degrees of Exertion or of Expended force. This is the sense of Resistance, the basis of our conception of Body, and our measure of Force, Inertia, Momentum, or the Mechanical property of matter.

Every feeling involves a consciousness of degree or amount: to be affected *more* or *less* in different circumstances is a consequence of being affected at all. Even when experiencing the pleasure of healthy exercise, or the pain of fatigue, we are aware of differences in the various stages of the feeling. Such differences make one part of the fact that we call knowledge (agreements being the other part).

To apply this to the case now before us. We have a certain feeling when called to exert our muscular energy in causing movement, or in encountering resistance. We have a certain degree of consciousness for some one degree of exertion; when the exertion increases, so does the consciousness. If a porter places on his back a load of one hundredweight, he has a peculiar and distinct muscular feeling associated with it; if thirty pounds were added, he would have a sense of the addition in the increased expenditure of force; if thirty pounds were removed, he would have a feeling of diminished expenditure. In short, there is a perfect discrimination of degrees and difference of muscular energy, which serves us as a means of discriminating the resistances that we encounter. Hence we are able to say that one body resists more than another—possesses in greater degree the quality that, according to circumstances, we call force, momentum, inertia, weight, or power. When we encounter two forces in succession, as in a wrestling match or a dead push, we distinguish the greater from the less.

22. Among the various occasions where the sense of graduated resistance comes into play, mention may be made, first, of the *momentum* or *force* of moving bodies. Where we have to check or resist something in motion, as in bringing a vehicle to rest, our sensibility to expended exertion leaves with us an impression corresponding to the momentum of the vehicle. If we were immediately after to repeat the act with another vehicle heavier or swifter than the first, we should have a sense of increased effort, which would mark our estimate of the difference of the two forces. Supposing the impressions thus made to be gifted with a certain kind of permanence, so that they could be revived at an after time, to be compared with some new case of checking a moving body, we should be able to say which of the three was greatest and which least, and we should thus have a scale of sensibilities corresponding to the three different degrees of moving force.

Such exercises as digging the ground, rowing a boat, or dragging a heavy vehicle, do not essentially depart from the case of the dead strain; and in all these instances, there is an estimate of expended force. Every carriage horse knows the difference of draught between one carriage and another, between rough and smooth ground, and between up hill and down hill. This difference the animal comes to associate with the carriage, or with the sight of the road, and in consequence manifests preferences whenever there is an opportunity; choosing a level instead of a rising road, or the smooth side in preference to the rough.

The appreciation of *weight* comes under the dead strain. We remark a difference between half an ounce and an ounce, or between five pounds and six pounds, when we try first the one weight and then the other. The generality of people can appreciate far nicer differences than these. A sensitive hand would feel a small fraction of an ounce added to a pound. In this respect, there would appear to be wide constitutional differences, and also differences resulting from practice, among different individuals. We are all sensitive to some extent, but there is for each person a degree of minuteness of addition or subtraction that ceases to be felt; this is the limit of sensibility, or the measure of delicacy in the individual case.

There are two modes of estimating weight, the relative and the so-called absolute. By relative weights we understand two or more present weights compared together; as when among a heap of stones we pick out what we deem the heaviest. Absolute weight implies a permanent standard, and a permanent impression of that standard. When I lift a weight and pronounce it to be seven pounds, I make a comparison between the present feeling and the impression acquired by handling the standard weight of seven pounds, or things known to be equivalent thereto. This absolute comparison, therefore, implies the enduring and recoverable sensibility to impressions of resistance, which is also a fact of the human constitution. We can acquire a permanent sense of any one given weight or degree of resistance, so as to be able at all times to compare it with whatever weight may be presented. A receiver of posted letters contracts an engrained sensibility to half an ounce, and can say of any letter put into his hand whether it produces a sensibility equal to or under the standard. This, too, is a result pre-eminently intellectual in its nature; the process of acquisition that brings it about, ranks as a fundamental property of our intelligence. The sensibilities that can assume this permanent character, so as to be used in comparison, without the presence of their original cause, are truly intellectual sensibilities.

The sensitiveness to relative weight, or to things actually compared together, may not imply great sensitiveness to absolute weight, which involves a greater or less degree of retentiveness or memory.

Although the use of the balance supersedes, to a very great extent, the sensibility to weight residing in the muscular system, there are occasions where this sensibility can display its acuteness. In many manual operations, weight is often estimated without the aid of the balance. In throwing a missile to reach a mark, an estimate of weight must enter into the computation of the force expended.

In appreciating the cohesiveness of tenacious bodies—the thickness of a dough, or the toughness of a clay—the same sense of resistance comes into operation. In like manner, the elasticity of elastic substances—the strength of a spring, the rebound of a cushion—can be discriminated with more or less nicety.

23. The second mode of muscular discrimination respects the Continuance of it. A Dead Strain of unvarying amount being supposed, we are differently affected according to its duration. If we make a push lasting a quarter of a minute, and, after an interval, renew it for half a minute, there is a difference in the consciousness of the two efforts. The endurance implies an increased expenditure of power in a particular mode, and we are distinctly aware of such an increase. We know also that it is not the same as an increase in the intensity of the strain. The two modes of increase are not only discriminated as regards degree, they are also felt to be different modes. The one is our feeling

and measure of Resistance or Force, the other stands for a measure of Time. All impressions made on the mind, whether those of muscular energy, or those of the ordinary senses, are felt differently according as they endure for a longer or a shorter time. This is true of the higher emotions also. The continuance of a mental state must be discriminated by us from the very dawn of consciousness, and hence our estimate of time is one of the earliest of our mental aptitudes. It attaches to every feeling that we possess.

The estimate of continuance attaches to dead resistances, but not to that alone. When we put forth power to cause Movement, as in lifting a weight off the ground, or in pulling an oar, we are aware of a difference in the continuance of the movement. We also know that we are moving, and not simply resisting. The two modes of exercising force are not confounded in our consciousness; we hold them as different, and recognize each when it occurs. Now, the continuance of movement expresses more to us than the continuance of a dead strain. It is the sweep of the organ through space, and connects itself, therefore, with the measure of space or extension. The range of a muscle's contraction, which is the same as the range or extent of motion of the part moved, is appreciated by us through the fact of continuance. Being conscious of a greater or less continuance of movement, we are prepared for estimating the greater or less extent of the space moved through. This is the first step, the elementary sensibility, in our knowledge of space. And, although we must combine sensations of the senses with sweep of movement, in our perception of the extended, yet the essential part of the cognition is furnished by the feelings of movement. We learn to know, by a process to be afterwards adverted to, the difference between the co-existing and the successive, between Space and Time; and we can then, by muscular sweep—that is, by the continuance of muscular movement—discriminate the differences of extended matter or space. This sensibility becomes a means of imparting to us in the first place the feeling of *linear* *extension,* as measured by the sweep of a limb, or other organ moved by muscles. The difference between six inches and eighteen inches is represented by the different degrees of contraction of some one group of muscles ; those, for example, that flex the arm, or, in walking, those that flex or extend the lower limb. The inward impression corresponding to the outward fact of six inches in length, is an impression arising from the continued shortening of a muscle. It is the impression of a muscular movement having a certain continuance ; a greater linear magnitude is a greater continuance.

The discrimination of length in any one direction obviously includes *extension* in every direction. Whether it be length, breadth, or height, the perception has precisely the same character. Hence superficial and solid dimensions, the size or magnitude of a solid object, come to be felt through the same fundamental sensibility to expended muscular force. All this will be understood more fully at an after stage, when we shall have to consider muscularity in connexion with the senses of Touch and Sight.

By means of the muscular sensibility associated with prolonged contraction, we can thus discriminate different degrees of the attribute of space, in other words, difference of length, surface, and form. When comparing two different lengths, we can feel which is the greater, just as in comparing two different weights or resistances. We can also, as in the case of weight, acquire some absolute standard of comparison, through the permanency of impressions sufficiently often repeated. We can engrain the feeling of contraction of the muscles of the lower limb due to a pace of thirty inches, and can say that some one given pace is less or more than this amount. According to the delicacy of the muscular organs, we can, by shorter or longer practice, acquire distinct impressions for every standard dimension, and can decide at once as to whether a given length is four inches or four and a half, nine or ten, twenty or twenty-one. A delicate sensibility to size is an acquirement suited to many mechanical operations; as in drawing, painting, and engraving, and in the plastic arts.

24. Under the foregoing head, we supposed the case of steady or uniform movement; and called attention to the power of discriminating the greater or less continuance of it. But movements may vary in their rate of Speed; and it is now to be considered whether or not the mind is affected when the speed is increased or diminished. This is also a mode of expending additional power; and it is not possible for us to increase the expended energy without being conscious of the fact. The only doubt that might arise is as to our being able to distinguish the various modes of increase—increase in the dead strain at any one instant, increase in the duration of the strain, increase in the duration of a movement, increase in the velocity of the movement—so as to be aware which mode we are under for the time. If we confounded all these modes of increase under a common impression of intensified energy, our muscular discrimination would be wholly inadequate to the perception of the external world; and, in particular, our ability to estimate extension would have to be referred to some other part of our constitution. But it is quite certain that we are differently affected under these various situations. Our consciousness is not the same when we augment the energy of a dead resistance, as when we protract the time of that resistance; nor is it the same when we prolong the duration of a uniform movement, and when we add to its speed. We are aware, when we accelerate our pace, not merely that more power is going out of us, but that such power is in one especial mode, which we distinguish from other special modes. This being assumed, we are cognizant of degree in the rapidity of our movements, and so possess the power of estimating another great property of moving bodies, the *velocity* of their motions. This measure is taken first on our own movements, and thence extended to other moving things that we encounter. When we follow a moving object with the hand, or with the eye, or keep pace with it, its velocity is transferred to ourselves, and estimated accordingly.

The feeling of the rapidity of muscular contraction has a further office. It is an additional means of measuring Extension. An increase of velocity in the same time corresponds to an increase of range or extension, no less than the same velocity continued for a greater time. Extent of Space thus connects itself with two separate discriminations—Continuance, and Velocity, of movement.

The distinct feelings from the various forms of muscular exercise, as formerly explained, whereby we are differently affected according as movement is slow or quick, are thus of great intellectual importance, as enabling us to be characteristically impressed by each varying degree of velocity. The soothing tendency of the slow motions, and the exciting effect of the comparatively rapid motions, are instrumental in enabling us to discriminate degrees of velocity directly, and of space indirectly.*

* A fourth variety of muscular discrimination may be pointed out as in constant use, namely, the sense of the amount of contraction of a muscle, and of the position of the limb in consequence. We are ordinarily aware not merely that we are putting forth a force of a certain degree and continuance, but that we are operating either at the beginning of the muscle's contraction, so to speak, or at some advanced stage of the contraction. This determines, of course, the attitude or position of the part moved. We know, in exerting the arm in the dark, whether it is extended or bent, and whether it is thrown before or behind. We know in grasping anything in the hand, whether the hand is very much stretched, or very much closed; and we can judge of the different degrees of contraction determining intermediate positions.

By this sensibility we are able, after experience, to estimate the magnitudes of bodies without moving the arm or the hand, or other organ. By the mere stretching of the arms, without attending to the movement implied in that stretch, we measure in our mind the length of an object, or of an interval. By the dead span of the fingers and thumb, we can estimate any length that is within the scope of the parts.

It is usual to describe this particular discrimination as a sense of the state of the muscle's contraction, and to regard it as the primary or typical form of the muscular sense. Now, the discrimination must no doubt be an original fact; one cannot see how it could be acquired; but the *meaning* given to it, the interpretation of the position of the limb, and of the magnitudes embraced between two outstretched parts, is wholly acquired. We must learn by experience what movements correspond to the transition from one mode of contraction to the other; extension must be measured first by movement. A definite fixed position of the two arms, of the two legs, of the jaws, of the

We have thus gone over the two great classes of muscular feelings enumerated at the outset of the chapter.* This

lips, or of the fingers and thumb, comes to represent a series of movements, and the corresponding estimate of space passed over by movement. With one hand resting upon the side of a box, and the other resting upon the top, we can tell the inclination of the two sides, without movement; our experience has made the feeling of certain combined dead tensions a symbol of a series of movements in different directions. Besides, if we would have an accurate appreciation of the amount of the contraction, we may still, in many cases, have to repeat the actual movements.

The importance of this mode of discrimination is perhaps best seen in the eyes. It enters into the explanation of the binocular feeling of solidity.

I have not inserted this feeling in the text among the fundamental discriminations of muscle, because it seems bound up with our sensibility to movement as there given. If, on the other hand, I were to assume the sense of the state of contraction as the primary feeling, the sense of movement would follow; since movement implies that the muscle passes through a series of states of contraction, and the conscious sequence of these states would be the mental fact of movement. It is possible that the feeling of movement may consist of the primary feeling of expended energy (given in its purity in dead resistance), modified by a muscular sensibility arising in the change from one stage of contraction to another. But, be this as it may, I think it enough to assume as distinct and fundamental the three modes of muscular discrimination discussed in the text.

* Sir William Hamilton, in his Dissertations on Reid, p. 864, has drawn a distinction between what he calls 'the locomotive faculty,' and the muscular sense, maintaining that the feeling of resistance, energy, power, is due to the first and not to the second. By this locomotive faculty he means the feeling of volitional effort, or of the amount of force given forth in a voluntary action; while he reduces the application of the term 'muscular sense' to the passive feeling that he supposes us to have of the state of tension of the muscle.

His words are: 'It is impossible that the state of muscular feeling can enable us to be immediately cognizant of the existence and degree of a resisting force. On the contrary, supposing all muscular feeling abolished, the power of moving the muscles at will remaining, I hold that the consciousness of the mental motive energy, and of the greater or less intensity of such energy requisite, in different circumstances, to accomplish our intention, would of itself enable us always to perceive the fact, and in some degree to measure the amount, of any resistance to our voluntary movement; howbeit the concomitance of certain feelings with the different states of muscular tension, renders this cognition not only easier, but, in fact, obtrudes it on our attention.'

The sense of expended energy I take to be the great characteristic of the muscular consciousness, distinguishing it from every mode of passive sensafundamental sensibility of our nature will come up again in a variety of connexions; and much has still to be said in order fully to explain the growth of the perceptions of Externality, Force, Space, and Time.

tion. By the discriminative feeling that we possess of the degree and continuance of this energy, we recognize the difference between a greater and a less stretch of muscular tension, and this appears to be the *primary* sensibility operating in the case. The other sensibilities of muscle, derived through the sensitive fibres, may aid us in the important discriminations between the different *modes* of increased energy above specified.

I may here express the obligations we are under to Sir William Hamilton for his historical sketch of the doctrine of the Muscular Sense, contained in the same note; which is not the least valuable and interesting of his many contributions to the history of mental science.

CHAPTER II.

OF SENSATION.

BY Sensations, in the strict meaning, we understand the mental impressions, feelings, or states of consciousness, resulting from the action of external things on some part of the body, called on that account sensitive. Such are the feelings caused by tastes, smells, sounds, or sights. These are the influences said to be external to the mental organization; they are distinguished from influences originating within, as, for example, spontaneous activity (the case we have already considered), the remembrance of the past, or the anticipation of the future.

The Sensations are classified according to the bodily organs concerned in their production; hence the division into five senses. But along with distinctness of organ, we have distinctness in the outward objects, and also in the inward consciousness. Thus, objects of sight are different from objects of smell; or rather we should say, that the properties and the agency causing vision are different from the properties causing smell, taste, or hearing.

The difference of the mental feeling or consciousness in the various senses is strongly marked, being a more characteristic and generic difference than obtains among the sensations of any one sense. We never confound a feeling of sight with a feeling of sound, a touch with a smell. These effects have the highest degree of distinctness that human feelings can possess. The discrimination of them is sure and perfect, although we sometimes try to assimilate them.

We are commonly said to have five Senses: Sight by the eye, Hearing by the ear, Touch by the skin, Smell by the nose, Taste by the mouth. In addition to these, physiologists distinguish a sixth sense, of a more vague description, by the title of *common* or *general sensibility,* as will be seen in the following extract from Messrs. Todd and Bowman. 'Under the name of *common* or general sensibility may be included a variety of internal sensations, ministering for the most part to the organic functions and to the conservation of the body. Most parts of the frame have their several feelings of comfort and pleasure, of discomfort and pain. In many of the more deeply seated organs, no strong sensation is ever excited, except in the form of pain, as a warning of an unnatural condition. The internal sensations of warmth and chillness, of hunger, thirst, and their opposites, of nausea, of repletion of the alimentary and genito-urinary organs, and of the relief succeeding their evacuation, of the privation of air, &c., with the bodily feelings attending strongly excited passions and emotions, may be mentioned among the principal varieties of common sensations.'

In this enumeration we can see several distinct groups of feelings, and can refer them to distinct bodily organs. Hunger, thirst, their opposites, nausea, repletion, and evacuation of the alimentary tube, are all associated with the *digestive* system. They might therefore be termed the digestive sensations. The privation of air causes a feeling whose seat is the lungs, and is one kind of sensibility associated with *respiration.* The sensations of warmth and chillness connect themselves with the skin, with the lungs, and with the organic processes in general. The genito-urinary organs have a class of feelings so special and peculiar, that they had better not be included under common sensibility

Looking at the important classes of feelings here indicated, important at least as regards human happiness and misery, considering also that they are but a few examples chosen from a very wide field, I consider it expedient to describe them in systematic detail. It is the business of a work like the present to review the entire range of human sensibility, in so far as this can be reduced to general or comprehensive heads; and the question is, where ought these organic feelings to be brought in? I know of no better arrangement than to include them among the Sensations. The only objection is the want of outward objects corresponding to them in all cases. The feelings of comfort or discomfort arising from the circulation, healthy or otherwise, are not sensations in the full meaning of the term; they have no distinct external causes like the pleasures of sound, or the revulsion of a bitter taste. But the reply to this objection is, first, that in most cases, if not in all, an external object can be assigned as the stimulus of the feeling; for example, in the digestive feelings, the contact of the food with the surface of the alimentary canal, is the true cause or object of the feeling; so the respiratory feelings may be viewed as sensations having the air for their outward object or antecedent. And with reference to the cases where feeling cannot be associated with an external contact, as in the acute pains of diseased parts, we may plead the strong analogy in other respects between such feelings and proper sensations. In all else, except the existence of an outward stimulus, the identity is complete. The *seat* of the feeling is a sensitive mass, which *can* be affected by irritants external to it, and which yields nearly the same effects in the case of a purely internal stimulus. So much is this the fact, that we are constantly comparing our inward feelings to proper sensations; we talk of being oppressed, as with a heavy burden, of being cut, or torn, or crushed, or burned, under acute internal sensibility. Moved by such considerations, I class these feelings with sensations, and place them first in the order of the Senses, under the title of Organic feelings, or Sensations of Organic Life.

In the Senses as thus made up, it is useful to remark a division into two groups, according to their importance in the operations of the Intellect. If we examine the Sensations of Organic Life, Taste, and Smell, we shall find that as regards pleasure and pain, or in the point of view of Feeling, they are of great consequence, but that they contribute little of the permanent forms and imagery employed in our Intellectual processes. This last function is mainly served by Touch, Hearing, and Sight, which may therefore be called the Intellectual Senses by pre-eminence; they are not, however, thereby prevented from serving the other function also, or from entering into the pleasures and pains of our emotional life.

SENSATIONS OF ORGANIC LIFE.

1. The classification of these is best made to proceed according to the parts where they have their seat. We have already adverted to the organic feelings connected with one tissue, the *muscular;* we shall now have to describe them in full. We must also notice the other tissues entering into the moving apparatus, namely, the *Bones* and *Ligaments.* The *Nerves* and *Nerve Centres* are subject to feelings dependent on their stimulation, growth, and waste, and on the changes that they go through in health and disease. The *Circulation of the Blood*, with the accompanying processes of secretion, assimilation, and absorption, may be presumed to have a distinct range of sensibility. The feelings connected with *Respiration* are of a less ambiguous character than the foregoing. The sensations of *Digestion* are numerous and prominent.

I. *Of Organic Muscular Feelings.*

2. In a quotation given from Dr. Sharpey, it is remarked that muscular sensibility 'is manifested by the pain which is felt when a muscle is cut, lacerated, or otherwise violently injured, or when it is seized with spasm.' These forms of pain are so many states of consciousness, having their seat or origin in the muscular tissue; the integrity of the nerves and nerve centres being likewise essential to this, as to every other kind of sensibility.

In describing the states of feeling arising through the Senses, named Sensations, we shall have to assign in each case the external agent that causes the Sensation (light, sound, &c.); to follow this up with an account of the action or change affected on the sensitive surface, (as the skin, the tongue, &c.); and then to proceed with a delineation of the feeling itself, according to the plan already laid down.

In the case of the proper muscular sensibilities described in the foregoing chapter, an external agent could not be assigned in the same sense as light is to the eye, or hard surfaces to the skin. But with reference to the first class in Dr. Sharpey's enumeration, 'cuts, lacerations, and violent injuries,' we discern both an external agent and an assignable change in the substance of the muscle. There is, in those circumstances, a sudden break in the continuity of the fibre, which is an effect productive of pains in almost any tissue of the body. This is manifestly one of the effects calculated to give an intense shock to the nerves, originating an energetic and pungent stimulus, which is transmitted to the centres, and there wakens up both consciousness and activity in violent forms.

Such being the bodily Origin, let us complete the consideration of the PHYSICAL side, by attending to the outward effects, or embodiments, constituting the Expression of the feeling. And the remarks on this point, as well as the further delineation of the conscious state, will serve to typify *acute physical pains* generally.

It is well known that a characteristic expression attends Acute Pains. The features are violently contorted, the voice is excited to sharp utterances, the whole body is agitated. Sometimes the ordinary movements are quickened; at other times contortions and unusual gestures are displayed. It would appear that the agency causing the pain is such as to stimulate to an intense degree the whole moving system. Indeed, the infliction of pain (within limits) is one of the customary modes of rousing an animal or a human being from lethargy to activity. There is also a well known form of the countenance that marks the condition of pain, being produced by certain movements of the mouth, the nostrils, and the eyes, to be afterwards analyzed; but whatever be the direction given to these movements, they are marked by the characteristic of violence or intensity.

The accompaniment of sobbing shows that the involuntary muscles and glands are also affected.

But we should give a most inadequate account of the embodiment of pain, if we failed to note the successive stages of the manifestation. While the first shock may have all the characters of violence and exalted energy now mentioned, there follows, after a time, a state of prostration and exhaustion, showing that these lively manifestations are no proof of an increase of vital energy on the whole. On the contrary, it is demonstrable that of vital energy on the whole there is a great decrease. Violent exercises of any kind soon wear out the strength; but the depression of vital power in all parts of the system—organic functions as well as muscles—after an attack of pain, is much beyond what would follow from the same discharge of muscular energy in the absence of pain. This is a most material consideration, which is not to be disguised by the show of increased energy in the early stages. The director of the medical staff of the British Army in the Crimea was gravely in error when he discouraged the use of chloroform in surgical operations, on the ground that pain is a stimulant. If the termination is taken into account as well as the beginning, pain in every form, so far from being a stimulant, destroys the vital energies. Not only does muscular exhaustion follow, but the organic processes—the circulation, respiration, and digestion—are greatly enfeebled, an effect that does not usually result from mere violence of bodily movement.

These bodily manifestations, which are the natural accompaniment of acute pain (arising as an effect of the same cause), by being freely indulged in, operate as a diversion and a relief to the mental system. There is probably a physical sequence in this fact also. Great muscular exertion draws off the circulation from the brain to the muscles; and the effusion of tears also in some way reduces the congestion. We are not, however, rashly to conclude that, under great pain, a free vent to all the manifestations is preferable to forced quiescence or suppression; there is a great expenditure of power under both modes.

3. To pass now to the MENTAL side, or the character of

the states in question, viewed as Feelings. We know, each one by our own consciousness, what they are; and they are generalized, pointed out, and understood, by such names as pain, suffering, agony, torture.

The *quality* of the feeling is pain. The *degree* is intense or acute. The measure is obtained in a twofold manner: by comparing the pain with other pains, and by the amount of pleasure that it can neutralize. Taken in both ways, we consider the sufferings of wounds, lacerations, and acute derangements of our sensitive tissues, to rank among our greatest sufferings, our worst miseries. As respects *specialities* of character, we find language employed to discriminate the nature of different pains. A cut or a scald is different from a fit of rheumatism or gout. Neuralgia is different from the electric shock. We describe the varieties by such epithets as burning, gnawing, shooting, racking; and there is a pathological interest in noting these distinctions.

Pain is apt to rouse some special emotion, in accordance with the general temperament of the individual. Grief, terror, or rage, may prevail according to the circumstances, there being a natural connexion between the shock of acute suffering and all these passions.

Our plan of description requires us next to advert to the Volitional characteristics of acute pain. The general principle of volition, as applied to pains, holds in this instance. Such pains, in proportion to their intensity, stimulate us to efforts for mitigating and putting an end to them when present, and for avoiding them when there is danger of their recurrence. The peculiarity of the case that most deserves notice is, that since, for a time, they are stimulants of activity, the disposition to work for their abatement is very powerful at first, but fails at last with the prostration of the energies. The effective force of our volitions depends upon the active power of the system at the moment; and a state that increases this power, even by a wasteful stimulation, reaps the benefit of that increase, while anything that depresses and destroys the vital functions, as severe pain does on the whole, to that extent paralyzes the action of the will. Hence, although a passing smart may waken up the activity, an intense and continuing pain will fail in the effect.

The movements that constitute the proper emotional manifestations, are apt to be mixed up and complicated with movements directed by the will with a view to relief. It is generally easy to discriminate the two classes, and it is important for understanding our mental structure that they should be discriminated. The volitional movements are such as are maintained solely because they bring a felt alleviation. If any specific posture is of this character, it is energetically adhered to ; and if the mere vehemence of the outburst is found to deaden our sensibility to the pain, we are induced thereby to keep up the gesticulations prompted in the first instance by the emotional wave. Even in the lower animals, when we witness the convulsions that follow a shock to the physical system, we may satisfy ourselves as to the existence of true volitional movements, in company with the demonstrations that are the proper embodiment of the pain.

If we wish to measure the volitional urgency of a feeling, we can adopt the same mode of comparison as that suggested for the degree of pleasure or pain. When two feelings prompt in opposite ways, the one that determines the conduct is said to be volitionally the stronger.

There remains now the bearing of the feelings in question on the Intellect. Here, as in the Will, there is a general principle, liable to exceptions and modifications according to the circumstances of each particular case. The principle is, that feelings are discriminated, identified, and remembered according to their degree, whether in intensity or in quantity. This law holds within a moderate range of excitement. A very feeble impression cannot be nicely discriminated, and is little remembered. But the limitation arises when the degree is excessive and overpowering. There is a pitch of physical agony that overpowers the purely intellectual function of discrimination ; and although retentiveness is stimulated by intensity, the remembrance becomes more and more inadequate to the fullness of the reality. Not only are we unable to re-instate the acuteness of the suffering, but we are unable to figure to ourselves even the character of the pain, until it has become familiar by many repetitions. When the same, or nearly the same, pain recurs, we can mark the agreement, which is a true intellectual function, requiring for its exercise the retentive property also; but we have little power of remembering or imagining the peculiar features, or the characteristic consciousness of an acute misery.

A good retentiveness for acute pains has not the intellectual importance possessed by the memory for sights and sounds, but it has a twofold practical importance. In the first place, on it depends the exercise of the will in the way of prevention. When a feeling ceases in the actual, it can have no volitional power, except as it is vividly presented in idea; and on this ground, the more lively the recollection, the more energetically are we moved in our precautionary labours as regards the future. The degree of retentiveness for pain is thus the intellectual foundation of Prudence. It is, in the second place, the foundation of Sympathy, or the power of entering into the feelings of others when suffering under a like infliction.

4. The muscular pains that have been the subject of the above description, are those arising from cuts, lacerations, and violent injuries, being the incidents that every tissue is liable to. We have not included the characteristic pain of muscle—*cramp*, or spasm. Cramp is well known to be a violent contraction of a muscle, in whole or in part, due to some irritation of the motor nerves that supply the muscle. It is a contraction probably far beyond what can be induced by a voluntary effort, and does not relate itself in any way to a power consciously proceeding from the brain. The state of cramp acts violently upon the sensitive fibres of the muscle; and, according to Dr. Brown-Séquard, the pain is in proportion to the resistance offered to the muscle's contraction. 'I suppose,' he says, 'a case of painful contraction of the anterior muscles

of the thigh; the pain is increased every time the contracted muscles are elongated; *i. e.*, when the resistance to the contraction is augmented; on the other hand, it diminishes when the resistance to the contraction is rendered less than it was, and, at last, *it disappears entirely, or almost entirely, when the resistance is completely, or almost completely, destroyed.*'—(Lectures, p. 7.) The pains in the uterus are of the nature of spasm, and are relieved by the discharge of the contents. An explanation is now afforded of what was at first considered a paradoxical fact, the production of pain by stimulating the anterior, or the motor, roots of the spinal nerves. The effect of such stimulation is to contract the muscles, not in that measured and moderate degree occuring in their contraction by the will, but with the violence of cramp, thereby imparting a shock to the sensitive nerves of the muscle. When the posterior, or sensitive, roots of the nerves are cut, the pain appears no longer. These explanations are interesting, as they remove what appeared objections to the discovery associated with the name of Bell.

It is not requisite to repeat the particulars of the systematic description for this peculiar case. It ranks with the class of acute pains in all the general characters. But it is, perhaps, in its nature the most acute and violent of any. We can discriminate it from cuts, scalds, inflammations, and sores; the familiar name 'racking' pain describes and classifies it. Wherever we have the experience characterized by this epithet, it is probable that the seat is in the muscles, and that the action is cramp or spasm. The involuntary muscles of the uterus, and of the alimentary canal, occasion the most aggravated forms of the pain.

5. Another class of feelings connected with the muscles may be specified under the same general head of Organic Feelings, those arising from *over-fatigue*. This cause is known to produce acute pains of various degrees of intensity, from the easily endurable up to severe suffering. It is not necessary to advert to these more specifically, they being sufficiently comprehended by referring them to the genus of acute pains

of the muscles; they are part of the misery attending manual toil; they are also used in punishment.

The characteristic state of supporting a heavy burden is a form of general depression, to which many modes of suffering are habitually compared.

Very different is the state of feeling produced by mere *ordinary fatigue*, which we may introduce in the present connexion. This is a state not at all painful, but the opposite. It is one of the pleasurable experiences allied with the muscular system.

In this case, there is a pleasurable feeling, more massive than acute. If a considerable number of the larger muscles have been in exercise, the sensibility is proportionably great. Various elements may enter into the effect. The circulation of the blood, directed strongly for a time to the muscular tissue, now returns in a more liberal supply to the other organs,—the brain, the stomach, &c., and the general sensibility of the system is increased. There is, in the next place, an agreeable reaction from what may have been the commencing pains of fatigue. Allowing for those two collateral effects, we are still to suppose that the muscle itself gives rise to a certain pleasurable feeling when in this state. The degree of it may be, on the whole, considerable; it is one of the pleasures of a life of hard exercise or bodily toil, and taken along with the luxurious slumbers and the general sensation of health following in its train, it must be regarded as an appreciable fraction of human enjoyment.

The connexion already remarked on between slow movements and approaching sleep, extends also to muscular repose and sleep. The massive sensation experienced as we fall asleep, has its seat, in no inconsiderable degree, in the muscular tissue, especially after hard exercise, when this sensibility is most powerfully manifested.

6. I will pass over with very few remarks the *Bones* and *Ligaments*. Their sensibility is exclusively connected with injury or disease, appearing in that case under the form of acute pain, a form of sensibility that it is sufficient to have

dwelt upon once for all. The minute discrimination of forms of pain is of great service to the physician, and, if susceptible of being accomplished with precision, would enter with propriety into a systematic delineation of the Human Mind. At present we require only to remark, that sensibility everywhere demands a distribution of nerve fibres, and that the bones and ligaments are supplied with these; and although not in great number, they are yet sufficient to agitate the nerve centres with overpowering intensity on particular occasions. The diseases and lacerations of the periosteum give birth to excessive pains. The ligaments are said to be insensible to the cut of a knife, while the feeling of their being wrenched is most acute and painful. In extreme fatigue, the ligaments and the tendons of the muscles would appear to conspire with the muscular tissue, in giving rise to the disagreeable feeling of the situation. The joints are noted on various occasions as the seat of pain; for example, in gout. The diminution of atmospheric pressure consequent on ascending a great elevation, causes an intense feeling of weariness in the hip joints. This is shown by experiments to be a muscular pain. The rarefaction of the air diminishes the support of the limb, and it falls down in the joint by its own weight, thereby becoming an additional burden to the muscles. Fracture of the bones and laceration of the ligaments are among the agonizing incidents of our precarious existence.

Organic Sensations of Nerve.

7. The nerves and nerve centres, apart from their action as the organs or medium of all human sensibility, have a class of feelings arising from the organic condition of their own tissue. Wounds and diseases of the nerves are productive of intense pains; witness tic-douloureux and the neuralgic affections of the brain and spinal cord. Nervous exhaustion and fatigue produces a well known sensibility, very distressing in its extreme forms; and repose, refreshment, and stimulants

engender an opposite condition through a change wrought on the substance of the nerve tissue.

The nervous pains arising from cuts, injuries, and disease of the substance, are characterized by a most vehement intensity. When a muscle is spasmodically contracted, the influence passes from the muscular fibres to the nerve, and the affection of the nervous fibres may then be supposed to be secondary ; but, in neuralgic affections, the influence comes at first hand, and not by propagation from some other tissue.

We have here, therefore, a manifest complication to deal with. The nervous substance is necessary to all sensibility ; strictly speaking, every form of pleasure and of pain is physically embodied in a certain condition of the brain and nerves. But we have to note, under the present head, the effects that arise from operating upon the tissue directly, and not through the organs of sense, or by means of the emotions. This direct action is exemplified in injuries and in diseases of the nerves ; in the use of stimulating drugs ; and in the agencies whereby the cerebral substance is nourished or impaired.

8. *Nervous fatigue* and exhaustion, when carried beyond a certain pitch, is an extremely trying condition. It is produced by excessive expenditure, in one or other of the forms of nervous exercise ; by intense pains, by excess of pleasure even, by over-much thought, or by too long continued activity of either body or mind. The effect is a deficient nourishment of the nerve substance, or a low order of nervous action. The resulting sensation can be more readily described. The most painful aggravation of the state occurs when a morbid activity is generated beyond the control of the individual, hurrying him for a time into still greater depths of painful exhaustion.

This state of mind merits a full and orderly delineation. Commencing as usual with the quality, we must attribute to it an exaggerated form of pain. This pain is marked not by acuteness or intensity, but by massiveness or quantity. It is a wide spread and oppressive sensation. Its peculiar character or tone cannot be seized by any descriptive phrase. I must appeal to each person's own experience for the perception of it. The re-action of an intense excitement, the exhaustion of a severe loss or grievous mortification, will bring up an instance of it to most minds. It will also be illustrated by contrast with the opposite state to be next treated of. The Expression of the feeling is one of pain, not acute, but deep-seated and engrossing; collapsed features, restlessness, fretting, and melancholy. The Actions prompted are usually something quite extravagant and misplaced. The getting rid of life itself is suggested when the condition assumes its most virulent forms. This is a proof of the total loss of freshness and health through the substance of the nervous system. Hence the final triumph of ennui :—

> I am aweary, aweary, O God that I were dead!

It is too powerful to be adequately remembered when the reality has passed away. The most obvious comparison that the state suggests is with excessive burden or toil in the moving organs.

To fix by a precise delineation this condition of organic nervous exhaustion is an extremely important attempt, notwithstanding the difficulties arising both from the imperfection of our language, and from the fluctuating and various nature of the condition itself. The importance lies in the great fact, that this state is the termination or final issue of a great many other forms of pain. The struggle that we maintain against painful inflictions of all kinds, whether bodily or mental, often preys at last on the substance of the nervous system, and produces as its result this new form of evil.

9. The consciousness arising out of the *healthy and fresh condition of the nerve tissue*, or out of the operations of the various artificial *stimulants*, is the exact contrast of the state now described. I do not inquire into the use and abuse of those stimulating materials, but merely advert to the effect common to them all, and for which they are had recourse to; an effect also to be reaped from the natural condition of the

nervous organs when in their vigour, as may be seen more particularly in early life.

Following a parallel course of description, we may say of the state in question, that the outward causes or antecedents are either healthy agents, or stimulants and drugs. The physical change in the tissue presumably contains one or other of these facts :—an abundant supply of arterial blood, or a great activity of nervous assimilation in the tracks or modes governing sensibility. The consciousness itself is pleasurable, and may ascend to very high degrees of pleasure, both in acuteness and in mass. The action and desire that it prompts are naturally for continuance unlimited, and the cast of thought is hopeful for the future. The intellectual persistence is, as in the other case, low ; that is to say, the state is one difficult to be remembered or imagined when once entirely gone, and when either the opposite condition, or some intermediate neutral one, has taken the place of it.

Organic Feelings of the Circulation and Nutrition.

10. The circulation of the blood through the arteries and veins by the force of the heart, the secretion of nutritive material and of excrementitious matter in the several tissues and glands, and the various acts of absorption corresponding to those processes—cannot be unattended with feeling. But the sensation arising out of the different degrees of vigour attending this course of operations, is both vague and difficult to isolate. We may surmise with some probability that the depression of a low pulse and languid circulation has its seat in the capillaries situated all over the body, or is a sensation of the circulating machinery. In this connexion, we may allude to the two formidable experiences—Thirst and Inanition, or privation of Food.

Thirst shows itself in a dryness of the mouth and throat, accompanied by a feeling of roughness and burning in the hinder walls of the gullet or the palate, and in the roots of the tongue. It is connected with a deficiency of water in the blood, as compared with the solid constituents. Hence it is brought on by profuse perspiration, by inhaling dry air, by taking solid food, and by partaking of saline or other matters that strongly attract water to themselves. It is sometimes present, as a sensation, when the mouth is not parched, and absent in the opposite case; this would imply some deranged state of the nerve centres.

Inanition is different from hunger; still, as regards their physical foundations, the two may be taken together when we come to speak of Digestion.

The feelings of Inanition and of Thirst, when carried to the extreme, are states of pervading, massive, deep, and intolerable wretchedness. They are far more intense than mere nervous depression, and therefore stimulate a more vehement expression and a more energetic activity. Even when not accompanied with the terror of death, they excite lively and furious passions. The unsophisticated brute is the best instance of their power. Like other organic states, they are not very easily realized after they are gone; but the fear, and stir, and energy that they produce at the time, leave a much more lasting impression than mere low spirits; we take far greater precautions against them than against nervous depression.

The final result of the healthy operation of the nutrient organs, on the one hand, and of the purifying organs, on the other, may be considered as a perfect state of the blood.

The consciousness growing out of a vigorous circulation, with all that this implies, may be looked upon as the most characteristic sensation of pure animal existence. There is a thrill of corporeal gratification, not very acute, but of considerable volume, a gentle glow felt everywhere, rendering existence enjoyable, and disposing to serene and passive contentment.

> Let me have men about me that are fat;
> Sleek-headed men, and such as sleep o' nights.

It seems to be through the circulation that we are sensitive to atmospheric changes, more particularly as regards moisture and dryness. It is found that in a dry atmosphere the capillary circulation is quickened, and in a moist atmosphere retarded. The influence of heat and cold probably extends to the circulation and the nutritive functions.

Feelings of Respiration.

11. 'Respiration is that function by which an interchange of gases takes place between the interior of an organized being and the external medium; and, in the animal kingdom, oxygen is the gas received, and carbonic acid the gas given out.' The aeration of the animal fluids or juices is an essential of their vitality; if this is put an end to, death ensues instantaneously; if insufficiently performed, the vigour of the animal is lowered, and a peculiar painful sensation experienced. In man and in air-breathing animals, there is a wind-apparatus, the lungs, inflated and contracted by muscles, so as to suck in and force out the air by turns.

In this action we have all the particulars necessary to constitute a Sense; *an external object*—the air of the atmosphere—which operates by physical contact upon the lining membrane of the tubes and cells of the lungs; *an organ of sense,* and a resulting *state of feeling,* or consciousness. The peculiarity of the case lies in its being almost entirely an emotional sense; generating feeling rather than yielding knowledge, or providing forms for the intellect; ranking, therefore, among the lower, and not among the higher, senses.

As respects the *object* of this sense, the external air, it need only be remarked, that the air differs considerably in its quality for breathing purposes, the chief point of difference being expressed by the term 'purity.' The purity is affected first by the loss of oxygen, which happens when the same air is repeatedly breathed, or otherwise consumed; secondly, by the accumulation of carbonic acid, from the same circumstance; and, thirdly, by the presence of foreign gases and effluvia arising from animal life, vegetation, or other causes. Closeness or confinement is the chief aggravation of all those impurities. Of the three evils—the loss of oxygen, the accumulation of carbonic acid, and the generation of effluvia of animal and other substances—the second is the least injurious; for, although the production of a carbonic acid atmosphere, by burning charcoal in a close room, is fatal to life, yet the quantity ordinarily occurring in rooms is not found to do any harm, if mixed with air otherwise pure. The loss of oxygen, and the diffusion of the gases of decay, are the main influences that deteriorate the atmosphere.

Of the *organ* acted upon, the lungs, a minute description is not necessary for our present purpose. The structure is so arranged by ramifications and doublings as to present a very extensive surface to the air; the surface consisting of a fine membrane, with capillary blood-vessels, thickly distributed on its inner surface. The exchange of gases takes place through the double medium of membrane and capillary tube. The muscular apparatus for sustaining the bellows-action, is the diaphragm and abdominal muscles, and the muscles of the chest or ribs. The integrity and vigour of these muscles, and of the centres that sustain and time their action, must be reckoned as a condition of healthy respiration.

The respiratory nerve centres are stimulated from all parts of the body, but chiefly from those that, like the muscles, are large consumers of oxygen. The portion of the eighth pair of nerves named the nervus vagus, is instrumental in keeping up the rhythm of the lungs, and is also necessary to the feeling of suffocation.

The *feelings* of Respiration, both pleasurable and painful, are well marked. They include the gratification from pure air, enhanced by the increased action due to muscular exercise; the various shades of oppression from over-crowded rooms and unwholesome gases; the distressing experience of suffocation, or want of breath; and the pains attendant on disease of the lungs.

12. The influence of pure and stimulating air abundantly inhaled, spreads far and wide over the system, elevating all

the other functions by the improved quality imparted to the blood. The indirect consequences do not altogether hide the grateful sensibility arising from the lungs themselves, and referred by us to the region of the chest; a sensation not very acute or prominent, but possessing that choice and well known quality, expressed by the term 'freshness,' or 'refreshing.' This quality manifestly implies a contrast; for it is felt only when we pass from a lower to a higher degree of aeration. We may experience it at any time, by holding in the breath for a little, and then allowing it full play. No technical nomenclature can increase the conception possessed by every one of this remarkable sensibility; but for the sake of comparison with the other parts of our mental constitution, an attempt at verbal description is necessary. As just remarked, the sensation turns upon the contrast of the greater activity of the lungs with an immediately preceding activity of an inferior degree. It may be affirmed that no feeling arises from the lungs, after a given pace has been established for a length of time; but any acceleration of the rate of exchange of the two gases (by no means depending altogether on the rate of breathing) does for a time yield that delightful freshening sensation, which tells so immediately on the mental system as a contribution to our enjoyment, and as a stimulus to our activity and to our desire for rural recreation and bodily exercise.

13. The feelings of insufficient and impure air are manifested in the forms of faintness, sense of exhaustion and weariness, and are doubtless due, not to the lung-sense alone, but to the lowered condition of the body at large. The characteristic sensibility of the lungs is shown in the state termed *suffocation,* arising from the want of air, as in drowning, in an atmosphere deteriorated by poisonous gases—such as chlorine or sulphurous acid, in attacks of asthma, and in voluntarily holding in the breath. 'After holding the breath for fifteen or twenty seconds during ordinary respiration, or forty seconds after a deep respiration, there arises an insupportable sensation over the whole chest, concentrated under

the sternum, and no effort can maintain the interruption of the respiratory acts. This urgent sensation of want of breath, when carried to its full extent by any mechanical impediment to the aeration of the blood, is one of the most painful and oppressive kind, and is referable to the pulmonary plexuses (of nerves) distributed to the bronchia, and perhaps on the walls of the lobular passages and cells. The impression made on these peripheral nerves by the absence of oxygen, and the undue presence of carbonic acid in the air in contact with them, is propagated to the spinal cord and medulla oblongata by the sympathetic and vagus, and there excites those combined actions of the muscles of inspiration which lead to the renewal of the air.'—(TODD and BOWMAN, II., 403.) The sensation is of the class 'racking pains,' and may be, in part, muscular.

Feelings of Heat and Cold.

14. The description of these important feelings comes properly under Organic Sensations, in so far as change of temperature affects all the organs of the body. Warmth, while abating the activity of the organic processes generally, induces in the skin a richer circulation, and a greater activity in the sweat, and in the oil glands. The various parts of the cuticle, the nails and the hair, are more abundantly produced. The sensory powers of the organ are greater, and the texture is softer and more polished.

Inasmuch as cold (not in excess) increases the activity of the muscles, the nerves, the respiration, and the digestion, the animal powers attain their maximum in cold climates, and in the winter season, allowance being made for constitutions unfitted to endure extreme depression of temperature.

Sudden changes of temperature derange the functions. A sudden increase will cause a slight feeling of suffocation, beating of the heart, and increased pulsation and respiration. A sudden chill makes breathing difficult, quick, and irregular, and increases the pulsations. The nerves lose their excitability both under a great depression, and under a great increase of temperature.

The feelings of heat and cold are very notable. Let us commence with *Cold.* The outward cause of this feeling is some influence tending to lower the temperature of the body. The natural heat of the blood is about 98°, and any contact below this point feels cold; any contact above it feels warm. There is a certain surplus heat generated in the human system, which enables us to live in a medium below 98°, without feeling cold; and if this heat be husbanded by clothing, a very great depression of external temperature may be endured. A room is warm at 60°. The outer air can be endured at freezing and far below, either by means of exercise, which evolves heat, or of clothing, which retains it.

An acute cold acts like a cut or a bruise, injuring the part affected, and causing painful sensations of the class arising from violent local injuries. The temperature of freezing mercury would destroy the skin like boiling water or a sharp cut.

The proper sensation of Cold arises from a general cooling of the body, or any considerable part of it, below blood heat. The term 'chillness' expresses the state of feeling, which is of the painful class. The degree is not acute but massive. In the worst forms, it is wretchedness in the extreme. To a person suffering from excessive chillness, some powerful stimulant, such as the taking of food, alcohol, or tobacco, is necessary to restore equanimity. The volition and the memory are proportionally impressed by the pains of cold, and they take a high rank in the reckonings of forethought and prudence.

It is a singular fact in our constitution, that an agency calculated to quicken the vitality of so many leading organs —muscles, nerves, lungs, stomach—should affect us so powerfully, by the depression of one organ. The fact is highly illustrative of the importance of the skin, whether from its organic functions or from its sensibility. Probably both circumstances enter into the case. It may be that the quickened vitality of all the other leading organs is unavailing for a perfectly healthy tone while the skin is depressed. But it must be also true, that we are in a peculiar degree sensitive to changes in the condition of the skin, owing no doubt to its great supply of nerves.

15. The consequences of *Heat* are, in nearly every particular, the opposite of those now stated. Acute or intense heats agree with intense colds in being simply destructive and painful. Within the point of injury to the tissues, heat is a pleasurable sensation. The pleasure of heat, like the pain of cold, is voluminous or massive. There are cases, however, distinguished by intensity rather than by quantity; indeed, this distinction of quantity and intensity, used as a part of the description of feelings, has its perfect type in the case of temperature, there being a physical reality corresponding to the mental facts. Sometimes we have great intensity and small quantity, as in the scorching rays of a fire, or a cup of hot tea: at other times we have large quantity with low intensity, as in a hot bath, a warm room, a warm bed. The hot bath is the extreme instance. By no other contrivance can such a mass of heat be brought to bear upon the human system; consequently this presents the sensation of warmth in its most luxuriant form. It is the intoxication of animal heat. We are unavoidably led to assume that this warmth must act powerfully on the sensitive nerves; for it is hardly to be supposed, that the organic processes are so greatly furthered by the sustained temperature as to exalt the pleasurable consciousness in this remarkable degree. Indeed, we may derange the system by excessive heat, without producing the painful feeling arising from cold.

In the case of morbid activity of the nervous system, warmth is a soothing influence, either by its physical effects, or by the nature of the sensation, or from both combined.

The feelings of Respiration, and those of Heat and of Cold, illustrate in a marked manner the fundamental doctrine of Relativity, or of change as a condition of consciousness. There is no feeling of respiration, unless by increase or diminution of the action of the lungs; and if we lived in an even temperature, heat and cold would be alike unknown. The induction of the principle of Relativity as regards these states is complete.

Sensations of the Alimentary Canal.

16. Digestion offers all the conditions of a sense. There is an external object—the Food; a distinct organ of sense—the Alimentary Canal and its appendages; and a set of Feelings arising from the contact, also distinct and specific. To treat these feelings under Taste, is to confound together two senses totally different in their character, although happening to have one common object or stimulant.

The *objects* of this sense are the materials taken into the body as food and drink. These materials are extremely various, but there is no corresponding variety in their action on the stomach. They can be reduced to a few general heads, according to their composition, it being found possible to assign a few leading substances that comprehend all the different sorts of material serviceable in nourishing the body. The following is an abstract of this classification :—

1st. *Water* and the watery liquids, including substances conveyed in solution, or suspension, in water.

2nd. *Saccharine* substances derived from the vegetable kingdom. These comprehend sugars, starch, gums, vinegar.

3rd. *Oily* substances. These include the various fats and oils as well as alcohol. Like the former group, they are composed of carbon and the elements of water, but in them the carbon is in a much higher proportion.

4th. *Albuminous* substances, containing nitrogen: fibrine, gelatine, albumen, caseine (matter of cheese), vegetable gluten. 'All the materials which make up this group are derived generally from the animal kingdom, with the exception of the last, which is contained in great abundance in wheat; similar if not identical principles exist in other vegetables. Wheat, indeed, consists of two substances—one referable to the saccharine group, the other to the albuminous, the former consisting of starch, the latter of gluten.'

Milk is found to contain matter of all the four classes: water, sugar, oily matters (butter), caseine.

The three first classes are incapable of nourishing the principal animal tissues, such as nerve, muscle, &c. They are fitted rather for supplying fat, bile, and matters used in the production of the carbonic acid that escapes from the lungs. Being supposed to be mainly destined for the supply of animal heat, by being combined with oxygen, or slowly burned, they were formerly termed *calorifacient;* but this is now reckoned a too narrow view. Experiments recently made have proved that their combustion is the chief source of muscular power; being an example of chemical combination transmuted into mechanical force, of which a parallel is found in the steam-engine. The same combustion may also be the source of the nerve force; the parallel case being the voltaic circuit, where the electricity is evolved from chemical combination in the cells.

The albuminous bodies are undoubtedly the tissue-forming material, having a composition fitted for the purpose. But they are not confined to this function; in their final transformations and decay, they may be at last oxidized and become the source of heat, muscular force, and nerve force, like the others.

Certain substances of the saline, earthy, or mineral class, are requisite; most of them being found in the usual articles of food. Salts of soda, potash, and lime, as well as iron and phosphorus, are essential ingredients.

The Stimulants are classified into spices, or condiments; vegetable alkaloids, as tea, coffee, cocoa; extractives, as creatin and creatinin, occurring in the juice of meat; and the alcoholic beverages. For the most part, these substances are not directly nutritive; they act as stimulants to the nervous system, and also retard the waste of tissue. The organic vegetable acids,—vinegar, the acids of fruit, and lactic acid, are in extensive use as an ingredient of food.

The differences that exist among the infinity of articles used as food are not at bottom so great as they seem. If we take the different species of grain,—wheat, barley, rye, oats, rice, maize, millet, we shall find they are all composed of the same ultimate materials, gluten and starch, though not in the same proportions. In like manner, the potato is a starchy vegetable, with a very small share of gluten, hence the defective character of it as an article of nourishment. Another difference among vegetables relates to their texture, as fitting them for being acted on during mastication and digestion,—a circumstance, however, that cooking can modify. Thus the potato is a much looser texture than grain. A third point of distinction among alimentary substances, is the extraneous essences that may enter into them, and affect the sense of taste, and the general relish, as in the difference between mutton and beef, chicken and venison, brandy and rum.

17. I extract from Quain's *Anatomy* the following general view of the *Organs of Digestion.*

'The *digestive apparatus* includes that portion of the organs of assimilation, within which the food is received and partially converted into chyle, and from which, after the chyle has been absorbed, the residue or excrement is expelled. It consists of a main or primary part named the *alimentary canal*, and of certain accessory organs.

'The alimentary canal is a long membranous tube, commencing at the mouth and terminating at the anus, composed of certain tunics or coats, and lined by a continuous mucous membrane from one end to the other. Its average length is about thirty feet, being about five or six times the length of the body. The upper part of it is placed beneath the base of the skull, the succeeding portion is situated within the thorax, and the remainder is contained within the cavity of the abdomen. In these several situations, its form, dimensions, and connexions, its structure and functions, are so modified that certain natural divisions of it, bearing different names, have been recognized by anatomists.

'It may be considered as composed of two parts: one situated above the diaphragm, and the other below that muscular partition, and therefore within the abdomen. The first division consists of the organs of mastication, insalivation, and deglutition; and comprises the *mouth*, the *pharynx*, and the *œsophagus*, or gullet. The second division consists of the organs of digestion, properly so called, and of those of defæcation; viz., the *stomach*, the *small intestine*, and the *great intestine*.

'The accessory parts are chiefly glandular organs, which pour their secretion into it at different points. They consist of the *salivary glands* (named the *parotid*, *submaxillary*, and *sub-lingual)*, the *liver*, and the *pancreas*. Besides these large glandular organs, a multitude of small glands, compound, follicular, or tabular, are collected together at certain points, or scattered over large portions of the inner surface of the alimentary canal: these are described along with the mucous membrane of each part. The remaining accessory organs are the *teeth*, the *jaws*, the *tongue*, and the *spleen*.'—Vol. III. p. 85.

18. The physiology of digestion must be very briefly stated here. The first stage is mastication, which serves the double purpose of breaking down the food and mixing it with saliva; the function of the saliva is now known to be to convert the starch into grape sugar, by a process of the nature of fermentation. The effort of mastication is purely voluntary; but when the food gets upon the back part of the tongue, it is passed into the bag of the pharynx and propelled down the gullet into the stomach by involuntary muscular contractions. In the stomach, it is exposed to the action of the gastric juice. This peculiar action is not as yet fully understood, but so far as the researches of physiologists have yet gone, the most reasonable conclusion is, that 'in man and the carnivora the fluid secreted by the stomach during digestion simply dissolves animal and vegetable substances of the azotized kind, so as to render them capable of absorption, without materially altering their chemical constitution, leaving starchy, oily, saccharine, and the allied substances but little or not at all acted on.' The matter that leaves the stomach to pass into the intestines, is known by the name of *chyme*. This is very soon mixed up with

two other secretions, the pancreatic juice and the bile from the liver. In the stomach and along the intestine, there is an absorption going on by two different ways. The one is by the lacteal vessels: these have the exclusive power of taking up the fatty matters, which constitute the chief part of the *chyle*, as their contents are named. The other is by the capillary blood vessels, by whose means the nutritive matter is taken at once into the circulation, but before reaching the heart it passes through the liver. The use of the pancreatic juice, which is poured into the intestine near its commencement, is to co-operate with the salivary glands in dealing with the starchy constituents of the food, and to contribute, probably along with other fluids, to the digestion of the fat. The functions of the liver are more complex and obscure. The bile appears to aid in the digestion of the alimentary matters; mixing with the fatty matters of the food, it is indispensable to their being absorbed in the intestines. The liver is further believed to form sugar and fat out of other elements passing into it by the circulation. The blood from the intestines, before returning to the heart, passes through the liver, and takes up the sugar formed independently there. In coursing through the intestine by the successive contractions of the tube, the material is lessened by absorption into the lacteals and blood vessels; at the same time it gathers new matter by secretion from the coats of the intestines, which matter is of the impure kind, and is destined to pass out of the system along with the husk and undigested remainder of the food.

Only the upper and lower ends of the alimentary canal are supplied with cerebro-spinal nerves. The vagus nerve is largely distributed to the stomach, and nerves from the same system to the rectum, but the intestine receives its supply from the sympathetic system. This corresponds with our experience of alimentary sensations, which are concentrated chiefly in the two extremities of the canal, while the intervening thirty feet of intestine is almost entirely without sensation in ordinary circumstances. The movements of the intestine are kept up by means of the sympathetic system of nerves.

19. And now with regard to the Feelings of Alimentary action. These are of the pleasurable kind when the action is healthy; pains are the result of disease and disorder.

Discussing first the sensation of taking food, we shall find a pretty general agreement as to its character. I do not speak of the feeling of Taste, but of the sensibility connected more particularly with the stomach, which extends even to the mouth in connexion with salivation, and is called *relish.* If we include the entire mass of sensation arising from a healthy meal, and lasting a certain time after the meal is finished, at which stage the operation of digestion in the stomach is the sole cause of what we feel, we may safely pronounce it to be an agreeable state of a high order. It has the characteristic of massiveness, or quantity, being a rich, luxuriant, satisfying sensation. Such is the character common to all kinds of healthy nourishment; but there is the greatest possible difference in the qualities of food as regards stomachic relish; from turtle to stale oat-cakes, or a piece of black bread, what a mighty interval! To the richer kinds of food belong a feeling intense as well as voluminous. The magnitude of the sensation is attested by its ability to submerge a great many irritations, and to make itself for the time the ruling element of the consciousness. This power brings it into comparison with such feelings as healthy exercise and repose, nervous elation, and the intoxication of warmth.

The energy of the Volition corresponds to the relish and to the stage of the operation. At first, the stimulus to action is intense and even furious. Appetite is inflamed by partial gratification; and until such time as the stage of fullness draws near, the pleasure shows itself in supplying impulse to continue it. Eating is among the most characteristic examples of the general law of Feeling-prompted Action that we can produce, being not only for the avoidance of pain, but also for the retaining and heightening of pleasure.

To complete the delineation of this mode of consciousness, we may notice the peculiarity of it as related to the Intellect. Here, however, we have only to repeat what has been said on most of the feelings hitherto discussed, that there is comparatively little permanence in idea when the state of the organs is such as to forbid the reality. But the reality is one that can never be long absent. As a general rule, it is true of digestive and all other organic sensations, that they are exceedingly powerful when present, and exceedingly little realized when absent. They are very unlike sights and sounds, loves and hatreds, and other states that the intellect can retain in the ideal form; to imagine with effect the relish of a feast when under nausea, passes the power of the most vigorous memory.

The sensation connected with the lower extremity of the canal is chiefly of the nature of a feeling of relief from pain.

20. Another important healthy sensation of the alimentary canal is *Hunger*, the state preparatory to the one just described.

The physical concomitants of hunger are a collapsed condition of the stomach, and a deficiency of nutritive material in the system. The sensitive nerves distributed to the mucous surface of the stomach are first affected, then the nerves of the lower intestines, and finally an influence of the general system adds to the pain and the feeling of depression. It is considered probable that the state of the muscular fibres of the stomach makes a part of the case.—(WEBER.) These are at first loose and uncontracted, but at a later stage their characteristic (peristaltic) movements are commenced upon the empty tube. The cutting of the nervus vagus (supplying the mucous surface) does not entirely abolish the feeling of hunger. The feeling itself is of the uneasy or painful class, with a degree of massiveness and engrossment corresponding to stomachic feelings in general.

The appetite for eating commences with a pleasant feeling, and consists of certain indefinite sensations in the region of the stomach, accompanied by stimulation of the muscles of chewing, and by the secretion of saliva. This passes next into an uneasy feeling; then come on oppressive gnawing pains, which are referred to the region of the stomach; these are followed by sensations of a still stronger kind derived from a more general action, under which the local feelings are submerged. This last is the state of inanition, or starvation.

Animals are driven in search of food after the nervus vagus is cut; which would seem to imply that the sense of starvation in the body generally is a part of the motive power of hunger. On the other hand it is contended, that when the digestion is diseased, the appetite for food is entirely wanting, however much the frame be suffering from want. The influence of the nerves and the nerve-centres is shown in the fact, that a desire of eating may exist when the stomach is full. In ordinary circumstances, the state of fullness of the stomach is followed by the sensation of Satiety.

21. The feeling of *Nausea* and *Disgust* is an effect indicating some great disturbance in the usual course of digestive operations. This state is associated with the act of vomiting, an act that may take place, '1. from the introduction of certain substances into the stomach, some of which, as bile, mustard, common salt, not becoming absorbed, must act simply by the impression they make on the mucous membrane; 2. By the introduction of emetics, as Tartar emetic, into the blood, or by the presence of certain morbid poisons in the fluid; 3. By mental emotion, as that excited by the sight of a disgusting object; 4. By irritation at the base of the brain.'—TODD and BOWMAN, II., p. 214. To these must be added sea-sickness. Inflammation of the brain in children usually shows itself first in violent vomiting. The act of vomiting is the result of a reflex stimulus, directed towards the muscles that compress the abdomen in the act of expiration of the breath. These muscles violently contracting, while the exit of the air from the lungs is shut up, squeeze the contents of the stomach upwards towards the mouth. The sensation of vomiting is in most cases horrible in the extreme. It proves by a strong instance the power of stomachic influences on the nervous

system. The sensation is one *sui generis*—no other feeling can at all compare with it. There are many forms of unendurable pain, but this has a virulence of its own, great both in quantity and in intensity. On the maxim that the abuses of the best things are the worst, the wretchedness of stomachic perversion would be a testimony of the aptitude for pleasure belonging to this part of the system.

The sensations of nausea are also accompanied by irregular movements of the muscles of the pharynx. These are the seat of the characteristic feeling of nausea. In the stomach also, the sensation may be connected with irregular, or anti-peristaltic movements in the muscular fibres.

The feelings of nausea and disgust, and the objects causing them, are expressed in our language by a variety of strong terms. The 'disagreeable' is originally what revolts the stomach, extended in its application to other forms of the unpleasing. 'Disgust' is the extreme opposite of relish. The fact that these words are among the strongest that the language affords to express dislike or aversion, proves how deep and intense is the feeling that they primarily refer to.

Besides the objects that produce disgust by actual contact with the alimentary canal, there are substances whose appearance to the eye is disgusting. Certain gases also affect the smell in the same way. Disgusting sights are mostly the result of association; but some nauseous smells act from the very beginning. The arrangements of human life, particularly address themselves to our protection against disgusts; and singularly enough, the chief things to be avoided are the products of living bodies themselves. This is the foremost aim of the operations of cleansing and the removal of refuse. The influences that stimulate a healthy digestion and relish are contrasted with their opposites by the term 'fresh,' which we spoke of already as a quality of respiration, but which has still more emphasis as opposed to the causes of disgust. The power of resisting nauseating influences is an indication of great stomachic vigour in the right direction.

There are many things entering into the *ugly*, or opposed to the beautiful; but nothing contrasts with beauty so entirely, or annihilates it so effectually, as a disgust.

22. The foregoing cases are intended to include the most prominent of our habitual and ordinary experiences in relation to the alimentary processes. With regard to the feelings arising from disease in the various organs of digestion, these are so many forms and varieties of pain. If we were to go systematically through the entire series of organs enumerated above, we should have to commence with mastication, and describe the pains and agonies which the *teeth* render familiar to us. Distemper of the salivary glands yields a sensibility, not of the acute kind, but annoying, and difficult to bear, like disordered secretions in general. The pains and disorders of the early stages of digestion, that is, in the stomach, where the sensitiveness is greatest, are very numerous, and are sometimes acute, but oftener not so. In proportion to the genial influence of a healthy digestion upon the general mass of sensibility, is the malign influence of an unhealthy digestive action. It is in extreme cases altogether overpowering, and renders futile almost every attempt to establish a pleasurable tone by other causes. The nervous connexion between the brain and the stomach is intimate and powerful; and shows itself in many ways. Not only is there a keen sensibility to stomachic states, but also a strong *returning* influence from the brain upon the digestive secretions in the way of supplementing their force, or aiding them by a stimulus from without.* This partial dependence of stomachic vigour upon a derived power from the cerebral mass, is well attested by the tendency of an overworked brain to bring on disordered digestion. On the whole, however, we must make allowance for differences of temperament. The stomachic sensibility will be found very unequal in different individuals, just as we find inequalities in the feeling of music, or any other

* Wagner states (*Elements of Physiology*, § 362), that 'Increased movements of the intestines have been observed when the corpora quadrigemina have been irritated.'

sense. Some persons count the feelings of digestion a very small item among the sources of pleasurable excitement; but I am led to suppose, from the prevailing attention to the choice and preparation of food, that, for the great majority of people, I have not overstated their importance.

On acute stomachic pains, it is not necessary to spend much discussion. They have their character chiefly from the great sensibility of the alimentary surface, which often makes a slight cause of irritation peculiarly keen and intolerable. On the subject of pains and distempers not acute, but connected with want of tone and vigour in the digestive system, or with deranged mucous surface, the pathologist and physician have much to describe. The stomach combines the nourishing and the purifying functions; and hence operates doubly upon the healthy condition of the blood, the general basis of bodily and mental vigour. A well-known form of depression accompanies deficiency in the excreting power of the alimentary canal; so much so, that a forced relief of the loaded organs produces a general exhilaration; the consequence of withdrawing impurity from the blood. But what chiefly interests us is to mark, as a specific mental experience arising out of many forms of alimentary derangement, the depression and ennui spread over the consciousness, at the times when any of these organs are failing to perform their part. This effect is one that, if not intense or acute, is powerful in its amount, and extremely difficult to combat, either by other stimulants, or by the action of the mind recalling or imagining situations of a less gloomy cast. It either resembles or else produces that physical depression of the nervous substance already considered; the likeness holds remarkably in the leading features, as in the distaste for existence while the state lasts, and in the extreme facility of forgetting it when it is gone. In the rational point of view, hardly any sacrifice is too much to prevent the frequent recurrence of this state, but so little hold does it take as a permanent impression, that the reason has very little power in the matter. Any feeling of general depression is easily forgotten when the animal spirits are restored; the evil then seems to have neither a local habitation nor a name.

We have now described the principal states of feeling that enter into the general conditions called physical Comfort and Discomfort. The most powerful constituent elements of these two opposite modes of existence, are the feelings of the muscular system as regards exercise, and the various classes of organic sensations above enumerated.

Feelings of Electrical States.

23. We shall touch upon only one other class of feelings before passing from this subject,—the feelings of Electric and Magnetic agencies. It is very difficult to say anything precise on this class of sensations, but their interest is such that we ought not to pass them unnoticed.

The *electric* shock from a Leyden jar is perhaps the simplest of all the electric effects; yet we are not able to describe the change that it produces on the tissues affected by it. When very severe it destroys life. The stroke of lightning is proved to be of the same nature. The peculiar feeling of this kind of electricity has its main character from the suddenness of the action; the painful effect is described as a shock or a blow. When pretty smart, it leaves an unpleasant impression behind, such as to render us averse to a repetition of the experiment. There can be no doubt of the disorganizing tendency of the influence when at all severe; and the impression is one that remains with us as a thing of dread, like a scald or the blow of a weapon. The *Voltaic* shock is very different, in consequence of the altered character of the discharge; an incessant current is substituted for an instantaneous shock. Still the painful character remains. The first contact causes a slight blow like the other; then succeeds a feeling of heat, and a creeping sensation of the flesh as if it were unnaturally wrenched or torn, which after a time becomes intolerable. The peculiar distorting sensation is carried to the utmost in Faraday's *Magneto-Electric Machine*, where the current, instead of continuing of one character, is changed from negative to positive, and from positive to negative, a great many times every second. The sense of contortion from this machine may be described as agonizing. Feebler discharges of this kind are employed as an electric stimulus in certain diseases. There seems to be a power in electricity to revive the action of torpid nerves; and after experience both of common and of voltaic electricity for the purpose, Faraday's invention has been adopted in preference to either.

24. The electricity of the Atmosphere is believed to be the cause of quite other sensations than the shock of the thunderbolt. In some states, this influence is supposed to kindle a genial glow in the human frame, while in other states, the effect is painful and depressing. Many persons complain of a disturbed irritated condition of body on the eve of a thunder-storm. The highly electrified state of the atmosphere in dry cold is generally considered as bracing; while part of the depression of moist sultry weather is attributed to the absence of electricity.* Much, however, remains to be proved in regard to these popular beliefs. The time of greatest influence on the human sensibility from this class of influences is the eve of an earthquake or volcanic eruption; in which case it is known that the earth's magnetism suffers violent disturbances. On these occasions, feelings of depression amounting to nausea and sickness overtake both men and animals, as if some great stimulus of a supporting kind were suddenly withdrawn.

25. The influence of magnetism has been applied to produce new and artificial sensations in such experiments as those of Baron Reichenbach; but as the same sensations have been caused by crystals, heat, light, chemical activity, and the living hand, they can hardly be assigned specifically to the magnetic action. Reichenbach records two different

* I am informed, as the result of the observations at Kew Observatory (adopted at the instance of the British Association, for observing atmospheric electrical states), that the electricity of the air is usually in proportion to the degree of cold.

classes of feelings arising in his patients, according to the polar direction of the agent; the one cool, refreshing, delightful; the other in all respects the opposite.*

SENSE OF TASTE.

This is a peculiar sense attached to the entrance of the alimentary canal, as an additional help in discriminating what is proper to be taken as food, and an additional source of enjoyment in connexion with the act of eating.

1. The substances used as food are more completely distinguished by the taste than by the digestion. The tastes of bodies are almost as widely different as is their chemical composition; but in order to have taste, a substance must be either liquid or soluble in the mouth.

The bodies acting on the sense of Taste are innumerable. They are found in the mineral, vegetable, and animal kingdoms, and many of them may be discriminated by means of this property.

Of mineral bodies, water and the elements of atmospheric air are remarkable for having no taste. But most other liquids and gases, and a very great proportion of solid substances, if capable of being dissolved by the saliva, have a distinct action on the palate. All acids, all alkalies, and nearly all soluble salts are sapid.

It is remarked that, in salts, the taste is determined more by the base than by the acid. Thus salts of iron have in general the inky taste; salts of magnesia partake more or less of the well known character of Epsom salts. There is also something of a common character in the salts of silver, of soda, of potash, of ammonia.

* I may remark, however, that although Reichenbach's experiments have been performed with an amount of care unknown before in this class of subjects, and rivalling the most approved scientific researches, yet it is still a doubt with many whether these effects be not due to imagination. Mr. Braid's admirable observations on the influence of ideas in producing bodily states, show to what great lengths the power of imagination may go in a peculiar class of temperaments.—(See his criticism on Reichenbach, and his writings generally.)

It is a curious fact, that the chemical combination $M^2 O^3$, or two atoms of a metal with three of oxygen (termed sesquioxides) causes sweetness. Alumina is an illustration; for alum is known to be sweet as well as astringent. The oxide of chromium is still sweeter. Glucina is the sweetest of all, and has its name from this quality.

The salt of silver, termed hypo-sulphite, and its combinations with hypo-sulphites of the alkalies, are the sweetest bodies known.

The salts of lime are bitter.

The organic alkalies are all intensely bitter; quinine, morphine, strychnine, are instances. The taste of strychnine is apparent when diluted with water, to the degree of one in a million.

There is a certain class of vegetable compounds, neutral bodies, which are at present characterized as the bitter and extractive principles of plants. I quote a few examples from the list given in GREGORY'S *Organic Chemistry*, p. 457.

Gentianine, from *Gentiana lutea*, forms yellow needles, very bitter. *Absinthine*, from *Artemisia absintheum*, or wormwood, is a semi-crystalline mass, very bitter, soluble in alcohol. *Tanacetine*, from *tanacetum vulgare*, is very similar to it. *Syringine* is the bitter principle of the lilac, *syringa vulgaris*. *Colocynthine*, the active principle of colocynth, is amorphous, intensely bitter and purgative.

Quassine is a yellow, crystalline, and very bitter substance, from the wood of *quassia amara*. *Lupuline* is the bitter principle of hops. *Liminine*, or *Limine*, is a bitter crystalline matter, found in the seeds of oranges, lemons, &c.

With regard to vegetable and animal substances in general, Gmelin remarks:—'Some organic compounds, as gum, starch, woody fibre, white of egg, &c., have no taste; others have a sour taste (most acids); or a rough taste (tannin); or sweet (sugar, glycerine, glycocol); or bitter (bitter principles, narcotic substances, and many acrid substances, also many resins); or acrid (acrid oils and camphors, acrid resins, acrid alkaloids); or fiery (alcoholic liquids, volatile oils, camphors).' (Chemistry, Vol. VII., p. 66.)

Not only are the different classes of vegetable and animal products distinguished by their taste, as apples from apricots, wine from cider, flesh from fat, but in every such class there are many distinguishable varieties. The class of wines, based on the common ingredient, alcohol, spreads out into innumerable kinds from the presence of sapid substances in quantity so small as to elude the search of the chemist. It is shown by this and by many other facts, that an extremely minute portion of a sapid substance may make itself acutely felt to the taste. The bitter element of soot, for example, can be distinguished in cookery to a very high degree of dilution.

Acids and bitters are said to be the most readily detected of all sapid substances; then saline, and lastly, saccharine. It has been found that one part of sulphuric acid in 10,000 of water, and one of sulphate of quinine in 33,000 of water, can be detected, when carefully compared with pure water. Sugar cannot be tasted when there is less than one in 80 or 90 of water; and of common salt, one part is necessary to 200 of water (Marshall's Physiology, I., 481).

2. The *organ* of Taste is the tongue, and the seat of sensibility is the mucous membrane covering its surface.

'The upper surface of the tongue is covered all over with numerous projections, or eminences, named *papillæ*. They are found also upon the tip and free borders, where however they gradually become smaller, and disappear towards its under surface.' These papillæ are distinguished into three orders, varying both in size and in form.

'The *large* papillæ, eight to fifteen in number, are found on the back part of the tongue, arranged in two rows, which run obliquely backwards and inwards, and meet towards the foramen cæcum, like the arms of the letter V.' 'The *middle-sized* papillæ, more numerous than the last, are little rounded eminences scattered over the middle and fore part of the dorsum of the tongue; but they are found in greater numbers and closer together, near and upon the apex.' 'The *smallest* papillæ are the most numerous of all. They are minute, conical, tapering, or cylindrical processes, which are densely packed over the greater part of the dorsum of the tongue, towards the base of which they gradually disappear. They are arranged in lines, which correspond at first with the oblique direction of the two ridges of the large papillæ, but gradually become transverse towards the tip of the tongue.'

'These different kinds of papillæ are highly vascular and sensitive prolongations of the mucous membrane of the tongue. When injected, they seem to consist almost entirely of capillary vessels ; the large papillæ, containing many vascular loops, whilst the smallest papillæ are penetrated by only a single loop. Nerves proceed in abundance to those parts of the tongue which are covered with papillæ, into which the nerve-tubes penetrate.' 'The papillæ are undoubtedly the parts chiefly concerned in the special sense of taste ; but they also possess, in a very acute degree, common tactile sensibility.'—QUAIN.

The nerves supplied to the tongue are the glosso-pharyngeal on the back part, and twigs of the fifth pair on the fore part. The former must be considered as in all probability the nerve of taste proper. The fifth pair, being a nerve of touch, can confer that high tactile sensibility distinguishing the tip of the tongue ; but there are no facts decisively showing any portion of this nerve to be the medium of pure taste. It is true that some so-called tastes, as the sour or acid, can be discerned by the tip, but these are properly of the nature of pungent or fiery stimulation, capable of acting on nerves of touch. A *bitter* taste, which appeals to the strict gustatory sensibility, is felt principally in the back part of the tongue. Fiery, cooling, and astringent tastes may arise through the lips and the gums, showing that they are merely effects on our common or tactile sensibility. Mustard acts on any tactile surface with variations of degree merely. It has not been possible to excite a pure gustatory sensation by irritating the fifth pair of nerves.

3. With regard to the precise localities of the tongue where the sensibility resides, there has been some difference of opinion. 'We conclude generally,' say Messrs. Todd and Bowman, 'with regard to the tongue, that the whole dorsal, or upper, surface possesses taste, but especially the circumferential parts—viz., the base, sides, and apex. These latter regions are most favourably situated for testing the sapid qualities of the food; while they are much less exposed than the central part to the pressure and friction occasioned by the muscles of the tongue during mastication. The central region, as a whole, is more strongly protected by its dense epithelium, and is rougher, to aid in the comminution and dispersion of the food.' But in addition to the tongue, 'the soft palate and its arches, with the surface of the tonsils, appear to be endowed with taste in various degrees in different individuals.'—I., 443.

The increasing sensibility of the tongue, from tip to back, serves as an inducement to move the food gradually onward in the direction of the pharynx, in order to be finally swallowed. The same sensibility, acting according to the general law of feeling-guided action, or volition, keeps up the mastication, whereby the sapid action of the food is increased by solution and comminution of parts. Thus it is that mastication is purely a voluntary act, while deglutition or swallowing is purely reflex and involuntary.

Among the conditions of taste, in addition to solubility, it is noticed that 'taste, like touch, is much influenced by the extent of surface acted on; and is also heightened by the motion and moderate pressure of the substance on the gustatory membrane.' In order to taste, also, the tongue must not be in a dry or a parched condition. 'The impression of cold air deadens the sense of taste.'*

* Another condition of taste, brought to light by the researches of Graham on 'Dialysis,' is that the substance should belong to the 'crystalloid' class of bodies, and not to the 'colloid' class. The colloids are represented by starch, the gums, caramel, tannin, albumen, gelatine, vegetable and animal extractive matters. Now, it is a law that these colloids do not pene-

4. The precise mode of action whereby the nerves of the tongue are stimulated has not as yet been explained. Taste may be produced by mechanical irritation of the surface, as by a smart tap with the fingers on the tip of the tongue, and by galvanism. A stream of cold air directed upon the tongue gives a cool saline taste, like saltpetre. If we look at the substances that cause taste proper, it appears probable, that their chemical constitution is the determining circumstance, whence it would seem that the action is a chemical one. A certain secretion from the blood vessels that line the papillæ of the tongue combines with the dissolved food, and the act of combination constitutes the stimulus of the nerve fibres. We know that a chemical action on any surface or tissue will suffice to stimulate a nerve and produce sensation; and it is difficult to assign any other mode of stimulus either in taste or in smell.

5. Having thus considered the external objects of the sense, and the structure of the organ, it remains for us to describe the mental phenomena, that is, the Sensations themselves. From what has been already said, the reader will gather, if he has not otherwise remarked it, that the tongue is the seat of a twofold sensibility, taste and touch. I go still further, and ascribe to it a threefold sensibility, viz.—touch, taste properly and strictly so called, and *relish*, or a participation in the alimentary sensations; the reasons are the following. First, there is an obvious continuity of structure in the tongue and alimentary canal, a common character of surface as regards mucous membrane, glands,

trate one another, except with slowness and difficulty; whereas a crystalloid body like sugar or salt penetrates a colloid very readily. Animal membranes belong to the colloid class, and accordingly while they are freely permeated by crystalloid substances, they resist the passage of starch, gum, albumen, gelatine, &c. This would be a sufficient reason for the absence of taste in these bodies. Graham remarks:—'While soluble crystalloids are always highly sapid, soluble colloids are singularly insipid. It may be questioned whether a colloid, when tasted, ever reaches the sentient extremities of the nerves of the palate, as the latter are probably protected by a colloidal membrane impermeable to soluble substances of the same physical constitution.'

and papillæ, which would imply some community of action and feeling, in the midst of diversity. 'We may here allude to a certain gradation that is apparent from the papillæ of touch, through those of taste, to the absorbing villi of the small intestines. Touch shades into taste, and at a lower point sensibility is lost.'—(Todd and Bowman, I., 441.) Secondly, the tongue, besides its power of discriminating niceties of taste that have very little reference to digestibility, can inform us at once whether a substance will agree or disagree with the stomach, and this it can do only by being, as it were, a part of the stomach, affected like it by wholesome or unwholesome contacts. Thirdly, the peculiarity we call relish, is not the same as a mere taste. For the type of taste, I may take such substances as common salt, quinine, soot, Epsom salts; for relishes, I would select butter and animal flesh; the savoury in cookery being made up much more of relishes than of tastes. The condition of the stomach governs the one, but not the other. After an attack of sea-sickness, a person is still in a condition to discriminate sour, bitter, alkaline, or acrid, when the choicest food excites no relish in the mouth. Fresh, disgusting, nauseous, are terms applying to the stomachic sensibility and to that portion of the tongue in sympathy with the stomach, and not to tastes as I understand them. With this explanation, I shall now proceed to examine in detail the sensations of the tongue.

6. Deferring for the present the consideration of the purely tactile sensibility, shared by the tongue in common with the skin and the inner surface of the mouth, we shall have to classify and describe the several kinds of sensations coming under both Taste and Relish. On the general plan of taking the least intellectual sensations first, we should commence with the relishes and disgusts of taste, which constitute its relation with the alimentary sensations already treated of. But these feelings need not be again gone into in the detail; all that appears necessary is to quote a few instances, with the view of illustrating still farther the distinctions we have drawn, between the alimentary sensations of the stomach and those

of the mouth, and between both and the proper sensations of taste.

7. The classification will therefore commence (I.) with *Relishes.* These are the agreeable feelings arising from the stimulus of food on the organs of mastication and deglutition; they are intense in degree. The substances that produce them in greatest amount are reckoned savoury by pre-eminence. Animal food has the highest power of exciting a vigorous relish, or that keen sensation so powerful as a stimulus to mastication and the taking of food, rendering the individual voracious for the time being. A healthy digestion and the state of hunger are the necessary conditions of a strong relish, whether in the stomach or in the mouth; from which fact, as already said, we can discern the difference there is between a mere taste and a relish. Butter and oils and fatty substances are relishes, used for that purpose along with the more insipid kinds of food, such as bread. Sugar is both a taste and a relish. Being one of the necessaries of animal life, as is proved by the function of the saliva in producing it from starchy substances, there is a direct craving for it throughout the system; and everything craved for in this way is likely to produce a far deeper impression than a mere sensation of taste.

The relish in the mouth is much more intense or acute than the feeling in the stomach, although this last may be more influential upon the general tone of the system by its amount. That the two interests are not altogether identical is shown by the circumstance that many tongue-relishes are hard of digestion. But I am not aware of any case where what passes in the mouth is found nauseous to the digestion; so far the two senses would seem to be in accord.

8. Relishes imply their opposite, *Disgusts.* This sensation is inspired by certain substances as part of their nature; at particular times it may arise from any contact whatever, the alimentary surface being in a state of distemper. Oily substances, when cold and solid, are relishes; but, when hot and liquid, readily disagree with the palate. Repletion renders

any kind of food distasteful, and some kinds absolutely nauseous. In every point of view, this feeling is as much dependent on the condition of the alimentary canal as on the material tasted.

The different degrees of relish and nausea exhaust all that part of taste in sympathy with digestion ; what follows, next in order, belongs (II.) to the distinctive sensibility of the tongue.

9. *Sweet* tastes. At the head of these, we must class the sugary taste, as being the most prevalent of all forms of sweetness. The sweetness of every kind of fruit, of bread, of milk, of alcoholic liquors, and of confectionery in general, is known to arise from sugar. Besides the relish, it acts strongly upon the sense of taste proper ; but no pleasure of mere taste can be compared in amount and influence to an agreeable alimentary feeling. We can lay it down as a rule, that the pleasures of taste proper have as a whole a less influential action than the other class, and this must serve as a defining circumstance for every individual of them. The feeling of a sweet taste is acute, but does not inspire the energy of volition that follows up a savoury morsel. When digestion is satisfied, there remains the enjoyment of sweets, and when the taste for these becomes cloyed by repetition, it is by an independent effect on the gustatory nerves.

But the great distinction of this feeling, and of all other feelings of taste proper, relates to the intellect, or to the power of discrimination belonging to this organ, whereby an indefinite number of substances can produce impressions recognized by us as totally different in character, which impressions of difference can remain or be recalled, after the original is gone, to compare with new cases that may arise, and to give that sense of agreement or disagreement whereon all our knowledge of the world is based. In the case of sweetness, for example, not only can we be affected with the pleasurable feeling or emotion belonging to it, but we can be distinctively affected by a great many substances possessing the quality ; we can identify some, and feel a want of identity in others; and we can so far retain the impression of a taste of yesterday as to compare it with a taste of to-day. This feature distinguishes the feelings of the mouth from organic feelings; it distinguishes in some degree tastes from relishes, although these last are also discriminated to a considerable extent; and it is the point of superiority which sight, hearing, and touch, have to a still greater degree over organic sensations.

10. *Bitter* tastes. These are exemplified by quinine, gentian, or bitter aloes. This, and not sourness, is the proper contrast of sweet. As sweetness is the pleasure proper to taste, so bitterness is the peculiar or distinctive form of pain inflicted through this sense. Without having the bulk and influence of the massive forms of pain, this sensation is highly intense in its own limited region, expressing itself by wryness and contortion of the features. The sweet and the bitter represent the two characteristic modes of acting on the pure gustatory nerves. They are distinct from relish on the one hand, which involves sympathies with the stomach, and from the modes of tactile sensibility on the other. The classes that remain involve (III.) in a greater or a less degree the nerves of touch.

11. *Saline* tastes. Common salt may be taken as an example of this class. Mineral waters, containing salts of soda, magnesia, and lime, have a saline taste. This taste is rarely an agreeable one, in many cases it is very disagreeable, but we should be disposed to describe the feeling, in most instances, as singular and characteristic rather than as either pleasing or the reverse. Of it, as of all that follow, the character is best expressed by saying, that it can be discriminated from every other.

The repulsive taste of Epsom salts would be termed a compound of the saline and the bitter.

12. The *alkaline* taste is usually more energetic than the saline, as might be expected, seeing that a salt is a neutralized alkali. But if the remark above made be correct, namely, that salts owe their taste principally to their base, the alkali

ought to have a considerable share of the saline in taste. Most mineral alkalies, and some earths and oxides of metals have characteristic tastes, rarely agreeable, and often not markedly disagreeable.

13. The *sour* or *acid* taste is much more uniform in its nature than either the saline or the alkaline; which we may fairly ascribe to the influence of the acid quality itself, irrespective of the constituent elements. This is a sharp, penetrating, pungent action, having, when very powerful, the pain more of a burn, than of a repulsive taste; in diluted forms it is an agreeable pungent stimulus to the mouth; hence the liking for vinegar (the sour of cookery as sugar is the sweet), and for acid fruits and vegetables. A galvanic current in the mouth causes sourness.

14. The *astringent* is a distinct form of the sensation of taste; as an example we may refer to the effect of alum in the mouth. It is evident, however, that in the acid action, and still more in this of astringency, we depart farther and farther from the proper feeling of taste. Astringent substances act on the skin and on the mucous membranes generally; and the influence lies in a kind of contraction or forcible shrinking of the part, to which we are sensitive whenever it occurs as a touch. The 'rough taste of tannin' may be put down under astringency.

15. The *fiery* taste of alcoholic liquors, mustard, pepper, camphors, and volatile oils, given in Gmelin's classification, seems to me to be happily designated. I am inclined to think that this too is more a tactile action than a gustative, although in some of the other substances entering with alcohol into wines, spirits, and malt liquors, there is a genuine stimulus of the taste. The *acrid* taste may be looked on as a form of the fiery, or astringent, combined with some ingredient of the bitter. On the other hand, the effect of peppermint resembles a cold contact on the skin. The pungency that marks all this class of sensations is a remarkable state of feeling, deserving to be once for all discussed at length. This discussion, however, I prefer to take

up under the sense of smell, the next in order in our arrangement.

16. With regard to the Intellectual aspect of Tastes in general, Longet observes that these sensations are deficient as regards the power of being remembered; and he gives as a proof the fact that, when we dream of being present at a repast, we see the viands but do not taste them. The fact is not beyond question, and besides, it is an extreme comparison; it contrasts the most intellectual of all the senses, the most abiding of all sensations, with those that are least so. It is so far true, that we do not recover sensations of taste so as to live habitually on the ideas of them, but they are slightly recoverable even as ideas, and for the purposes of identification and contrast, they may be recovered to a very great extent. A wine tasted to-day can be pronounced the same or not the same as a wine tasted a week ago, while well marked tastes may be remembered for years in this way.

The intellectual character of the sense is also illustrated by its improvability. A wine-taster, a cook, or a chemist, can acquire a delicate sensibility to differences of taste, implying that its impressions can find an abiding place in the memory.

SENSE OF SMELL.

This sense is in close proximity to the organ of Taste, with which smell frequently co-operates; but we may consider it as placed at the entrance of the lungs to test the purity of the air we breathe.

1. The *external objects* of Smell, the material substances whose contact produces the sensations, are very numerous. They require to be in the gaseous state, in the same way that the objects of taste require to be liquified. Solids and liquids, therefore, have no smell except by being evaporated or volatilized.

The greater number of gases and vapours are odorous. Of inodorous gases, the principal are the elements of the atmosphere, that is to say, nitrogen, oxygen, vapour of water or steam, and carbonic acid.* In the long list of gaseous bodies recognized by the chemist, we find very generally some action on the nostrils,—carbonic oxide, sulphurous acid, chlorine, iodine, the nitrous gases, ammonia, sulphuretted and phosphoretted hydrogen, &c., the vapour of muriatic, nitric, and other acids. The singular substance *ozone*, produced occasionally in the atmosphere, is named from its smell, which is the smell of sulphur, and of the odour given forth by electricity. Some of the metals and solid minerals give out an odour, as, for example, the garlic smell of arsenic, and the odour of a piece of quartz when broken. The effluvia of the vegetable kingdom are countless; besides such widely spread products as alcohol and the ethers, a vast number of plants have characteristic odours, usually attaching to their flowers. The animal kingdom also furnishes a variety of odours; some general, as the 'scent of blood,' and others special, as musk, the flavour of the cow, the sheep, the pig. 'All volatile organic compounds,' says Gmelin, 'are odoriferous, and most of them are distinguished by very strong odours; *e.g.* volatile acids, volatile oils, camphors or stearoptenes, and alcoholic liquids; marsh gas (carburetted hydrogen), and olefiant gas, have but very little odour.'

The pleasant odours, chemically considered, are hydrocarbons; that is, they are composed chiefly of hydrogen and carbon. Such is alcohol and the ethers, eau de Cologne, attar of roses, and the perfumes. Many smells, however, elude investigation from the minuteness of the substance causing them. Thus the vinous flavour is due to a substance which the chemist has been able to separate, being termed the œnanthic ether; but the bouquet of individual wines has not been laid hold of.

* With regard to carbonic acid, the assertion as to the absence of smell is true of the amount present in the atmosphere: but, collected in mass, this gas has a slightly pungent, somewhat acid odour. As with pungent odours generally, the effect is probably due to the irritation of the nerves of the fifth pair, and not to the proper olfactory sensibility.

The repulsive and disagreeable odours very frequently contain sulphur. Sulphuretted hydrogen is one of the most common of the disgusting class.

The worst smelling substances as yet discovered have arsenic for their base, as will be seen from the following extract. (GREGORY'S *Chemistry*, p. 382.)

'When acetate of potash is heated along with arsenious acid, a very remarkable liquid is obtained, which is the oxide of a new radical. This liquid, which is spontaneously inflammable, and has a most offensive alliaceous smell, has long been known in an impure state, under the names of liquor of Cadet, and *alcarsine.* Bunsen, by a long series of the most profound and persevering researches, established its true character as the oxide of the radical *kakodyle.*' This radical, when obtained, 'is a clear liquid, refracting light strongly. When cooled, it crystallizes in large square prisms, and acquires, when pure, the appearance of ice. Its smell is insupportably offensive, and its vapour is highly poisonous. The two latter characters belong to all the compounds of kakodyle, with hardly an exception.' Protoxide of kakodyle, the chief ingredient in the liquor of Cadet, is most offensive to the smell, and very nauseous to the taste. 'Chloride of kakodyle is a volatile, horribly fetid liquid, the vapour of which attacks strongly the lining membrane of the nose, and provokes a flow of tears.'

The pungent odours have ammonia for their type. The volatile alkali, nicotine, the element of the snuffs, is an instance. In smelling salts, ammonia is the substance given forth.

Liebig has been able to lay hold of, and isolate, the substance that gives the odour of roast meat. Burning fat gives forth odours that exemplify the volatile oils specified by Gmelin.

2. The *development* or production of odours is favoured by a variety of circumstances. Heat, by its volatilizing power, and by promoting decomposition, is the most powerful agent. Light, also, which carries forward the development of the plant, is an odoriferous influence. Hence the abund-

ance and variety of odours in warm and sunny climates, and in the summer season. The presence of moisture is often favourable; but the manner of acting of this agency is not always obvious. It may perhaps dissolve solid matters, and so put them in the way of being volatilized; this may be the cause of the evolution of perfumes after a shower. On the other hand, some flowers are most odorous when dried. Friction is a source of odours; by rubbing two pieces of flint or siliceous rock a smell is given forth; sulphur treated in the same way has a smell. Many of the metals have the same property. Doubtless some ingredient is volatilized by the rubbing action.

3. The *diffusion* of odours is an interesting point, and has been cleared up by the researches of Professor Graham. Some odours are light, and therefore diffuse rapidly and rise high; as, for example, sulphuretted hydrogen. Such is evidently the character of the aromatic and spice odours; they, by their intensity and diffusibility combined, are smelt at great distances. The Spice Islands of the Indian Archipelago are recognized far out at sea. It happens, however, that the sweet odours are remarkably persistent, while the sulphuretted compounds, which are among the most nauseous, are very rapidly destroyed in the atmosphere.

The animal effluvia (excepting sulphuretted hydrogen) are dense gases, and are diffused slowly. They do not rise high in the air. In scenting, a pointer keeps his nose close to the ground. The unwholesome effluvia of the decaying matter laid on the soil is avoided by getting to a moderate height; a person lying will smell what would not be smelt by one standing. The danger of sleeping on the ground in tropical swamps is a matter of fatal experience; swung in a tree fifty feet high, one may pass the night safely. Here diffusibility is one, although not the only circumstance; during the night, the ventilation or upward current from the ground is arrested, and the malaria, being little diffusible or buoyant, settles on the surface.

4. We have next to consider the *organ* of smell, that is

the Nose. 'This organ consists of, first, the anterior prominent part, composed of bone and cartilage, with muscles which slightly move the latter, and two orifices opening downwards; and secondly, of the two nasal fossæ, in which the olfactory nerves are expanded. The narrow cavities last mentioned are separated one from the other by a partition (the septum of the nose) formed of bone and cartilage; they communicate at the outer sides with hollows in the neighbouring bones, and they open backwards into the pharynx through the posterior nares,' or openings. The sensitive surface is a membrane lining the whole of the interior complicated cavities, called the *pituitary* or *Schneiderian* membrane. The tortuosity of the passages of the nose gives extent of surface to this membrane, and thereby increases the sensibility of the nose as a whole. I shall quote part of the anatomical description of this sensitive tissue. 'The cavities of the nose are lined by a mucous membrane of peculiar structure, which, like the membrane that lines the cavity of the tympanum, is almost inseparably united with the periostium and perichondrium, over which it lies. It belongs, therefore, to the class of fibro-mucous membranes, and it is highly vascular. Named the pituitary membrane, it is continuous with the skin, through the anterior openings of the nose; with the mucous membrane of the pharynx, through the posterior apertures of the nasal fossæ; with the conjunctiva (of the eye), through the nasal duct and lachrymal canals; and with the lining membrane of the several sinuses (hollows) which communicate with the nasal fossæ. The pituitary membrane, however, varies much in thickness, vascularity, and general appearance in these different parts.' With regard also to the distribution of the olfactory nerve on the membrane, there are great differences in the parts, the general fact being that the distribution is most copious in the interior parts of the cavity or those farthest removed from the outer openings. The parts near the openings are supplied with nerves from the fifth pair, which give to these parts a tactile sensibility, excited by pungent odours, and by cold.

The olfactory nerve is the most conspicuous of the nerves of sense; it passes inward to a special ganglion, called the olfactory ganglion, which is a prominent object in the brain of all the vertebrate animals, and in the lower orders stands forth as a distinct lobe, or division, of the encephalon.

5. The *action of odours* on the membrane of the nose has next to be considered. On this subject, as on the action of sapid substances on the tongue, much remains to be known. Nevertheless there are some interesting facts which show that the action is of a chemical nature, or at least depends upon chemical conditions. For the following statements I am indebted to Professor Graham.

Odorous substances in general are such as can be readily acted on by oxygen. For example, sulphuretted hydrogen, one of the most intense of odours, is rapidly decomposed in the air by the action of the oxygen of the atmosphere. In like manner, the hydro-carbons, above alluded to as odorous, are all oxidizable,—the ethers, alcohol, and the essential oils that make the aromatic perfumes. The gases that have no smell are not acted on by oxygen at common temperatures. The marsh gas, carburretted hydrogen, is a remarkable case in point. This gas has no smell. As a proof of the absence of the oxidizable property, Professor Graham has obtained a quantity of the gas, from the deep mines where it had lain for geological ages, and has found it actually mixed up with free oxygen, which would not have been possible if there had been the smallest tendency for the two to combine. Again, hydrogen has no smell, if obtained in the proper circumstances; now this gas, although combining with oxygen at a sufficiently high temperature, does not so combine at any temperature endurable by the human tissues.

It is farther determined, that unless a stream of air containing oxygen pass into the cavities of the nostrils, along with the odoriferous effluvia, no smell is produced. Also, if a current of carbonic acid accompanies an odour, the effect is arrested.

In the third place, certain of the combinations of hydrogen have been actually shown to be decomposed in the act of producing smell. Thus, when a small quantity of seleniuretted hydrogen passes through the nose, the metallic selenium is found reduced upon the lining membrane of the cavities. The action on the sense is very strong, notwithstanding the minuteness of the dose; there is an intensely bad smell, as of decaying cabbage, and the irritation of the membrane causes catarrh.

These facts, so far as they go, prove that there is a chemical action at work in smell, and that this action consists in the combination of the oxygen of the air with the odorous substance. The effect of *ozone*, which is considered a more active form of oxygen, and therefore not oxidizable, may be to decompose the nasal mucus, and so to stimulate the nerve of smell.*

6. We pass now from the physical to the mental phenomena of smell; the *sensations*, or peculiar states of consciousness, that all those physical antecedents end in giving birth to. Unavoidable allusion has already been made to these mental effects in the description of the smelling substances.

'Linnæus has divided odours into seven principal classes; 1st. *aromatic*, as the carnation, the laurel, &c.; 2nd. *fragrant*, as the lily, the crocus, the jasmine, &c.; 3rd. *ambrosiac*, among which are musk and amber; 4th. *alliaceous*, which are agreeable to some persons and disagreeable to others, and have more or less of the character of garlic,—assafœtida, for

* The minuteness of the particles of bodies acting on the sense of smell has often been dwelt upon as a striking example of the divisibility of matter. Sulphuretted hydrogen in the atmosphere, in the proportion of one to a million, is distinctly perceptible. Ammonia is perceptible in the proportion of 1 to 33,000.

The following minute quantities of different substances spread out on the surface of smell cause a distinct sensation;—of phosphuretted hydrogen $\frac{1}{3000}$ gr.; of sulphuretted hydrogen $\frac{1}{30,000}$ gr.; of Bromine $\frac{1}{40,000}$ gr.; of oil of resin $\frac{1}{1,300,000}$ gr. A still smaller quantity of musk than the last given, smells strongly; but the actual measure has not been ascertained.—(Valentin.) Among the instances of powerful and far-reaching odours we may rank the roasting of meat and many other odours of the kitchen, burning wood, and tobacco.

example, and several other gum-resinous juices; 5th. *fetid*, as those of the goat, of the rag-wort *(orchis hircina)*, valerian, &c.; 6th. *virulent*, as those of Indian pink *(l'œillet d'Inde)*, and many plants of the family of the solaneæ (from solanum, the night-shade); 7th. *nauseous*, as the gourd, the cucumber, and those of its class.'—LONGET, p. 151.

Of several classifications quoted by the same author, the above seems to me the best, but even that one is by no means free from objections. The three first classes, the aromatic, fragrant, and ambrosaic, do not appear to have very strongly marked differences; nor is the distinction between fetid and nauseous a generic one.

As in describing taste, I shall proceed upon the plan of stating,—first, the odours that owe their character to sympathy with the vital organ in alliance with the sense, namely, the Lungs; secondly, those that appeal to the purely Olfactory sensibility; and thirdly, those involving an excitation of the nerves of Touch.

7. *Fresh* odours are such as have an action akin to pure air, or coolness in the midst of excessive heat; an action mainly respiratory, or tending to increase the activity of the lungs, and with that the physical energy of the system. Many of the balmy odours of the field and the garden have this effect; musk, eau-de-Cologne, and other, but not all, perfumes are included in the same class; the odour of the cow is both fresh and sweet. We may recognize them by their effect in stimulating and reviving the system under the oppression and suffocation of a crowded assembly. Such odours are not always fragrant in their character, for we might cite cases of unpleasant effluvia that seem to refresh and stimulate the system. The odour of a tan-yard is perhaps a case in point. The nervous connexions of the nostrils with the lungs enable this reaction of the one upon the other to take place. Or the influence of the gases may be on the surface of the lungs rather than on the nose, a thing not at all unlikely in many cases coming under both freshness and the opposite. On this supposition, these

would be smells falsely so called, and would correspond to the relishes and disgusts described under taste.

8. The opposite of freshness is shown in the *close* or suffocating odours. The effluvia of crowds, by acting on the lungs, have pre-eminently this damping and discouraging action on the powers of life; whence it is that we seek the open air, and the solitudes of nature, to shake off the depression of rooms and of cities. The effluvia of warehouses, stores, and mills, where cotton, wool, cloths, &c., are piled up, and where ventilation is defective, are of a like unwholesome description. The smell of a pastrycook's kitchen is sickening. The action of highly-heated iron stoves seems of the same nature; also the smell of a woollen screen when held too close to the fire. In these last instances, there is believed to be an evolution of the unwholesome and suffocating gas, cyanogen, from the destructive decomposition of the woolly particles floating in the air, or making part of the screen.

9. Although we may not be able to affirm that any class of odours stimulates the stomach by a direct influence, as fresh odours do the lungs, there can be no doubt as to the existence of a class of the opposite kind, the disgusting or *nauseous* odours. That is to say, there are certain gases, of which sulphuretted hydrogen is an example and a type, that pervert the action of the alimentary canal, as some tastes do. It is doubtful, at least so far as my information goes, on what surface these effluvia operate, whether on the membrane of the nose exclusively, or (as is probable) partially on it and partially on the mucous surface of the tongue, throat, and stomach. But whatever be the seat of action, the fact in question is one sufficiently well marked to make the specific difference of a class.

10. It may be a question whether the foregoing classes are true and proper effects on the organ of smell; no such ambiguity attaches to the odours that we term *sweet* or *fragrant*. These represent the pure or proper pleasures of smell; the enjoyment we are able to derive through the olfactory nerves and ganglion. They include the substances that convey

along this channel to the mind a perfectly pleasurable stimulus. The sweetness may accompany freshness or it may not. The odour of the violet is a pure instance; the rose, jasmine, orange, lemon, lavender, rosemary, are well known examples of odorous plants. The cases of sweetness enjoyed with some other quality are also extremely numerous.

Sweetness is a name for a variety of pleasures. Derived originally from taste, it is extended to smells, to sounds, and to several of the higher emotions, such as the tender affections, and the beautiful in nature and in art. These feelings are so far of a kindred nature, as to suggest and support each other. They all agree in being forms of pure passive pleasure. In this respect, they resemble muscular repose, warmth, and healthy digestion; but they are more acute than these states; they are also more intellectual, as shown both in discrimination and in ideal persistence, which gives the superiority indicated by the name 'refinement.'

11. The opposite of sweet in odours is described by the general name *stinks;* the expressive word bitter is not usually applied to smell. The term 'mal-odour' has been proposed, and would be a convenient word. If we leave out both the nauseous odours, and certain other forms of the disagreeable to be afterwards described, this class will be limited considerably. Assafœtida may be given as an example of an odour intensely repulsive by its action on the olfactory nerves alone. The cadaverous odour is of the repulsive kind, but it is only one of many forms of disagreeable effluvia arising from animal decay. The aroma of some plants, as those quoted by Linnæus, has an intensely unpleasant action. The disagreeable marsh smell may be experienced in its strongest form by squeezing in the fingers the brown scum of a stagnant pond, and applying them to the nose. The varieties of bad odours are endless.

As sweetness is the proper pleasure of smell, the effect of a stink is the proper pain of the organ,—the influence originating the peculiar form of misery that we are adapted to receive by means of this sense. The sensation may be specified as the nose-pain. Of an intense, rather than a massive character, we are stunned and discomposed, but not necessarily depressed or prostrated by it. It resembles in this respect a bitter taste, and is contrasted with the massive pains of chillness, indigestion, or disgust. The expression is in accordance with the acuteness of the sensation, being an intense contortion of the features, chiefly about the nose. A sort of hysteric smile may likewise be provoked.

The peculiar feeling of an ill smell is often appealed to metaphorically, to express the feelings caused by human conduct.

12. The name *pungent* is applicable to a large class of odours, and the quality enters as an ingredient into many more. Ammonia is the type of substances producing this sensation. Nicotine, the snuff odour, is the best known example, a substance having a chemical analogy to ammonia. Pepper, mustard, and many of the acid effluvia have a pungent action. This effect, however, is not an olfactory effect in the proper sense of the word; like astringency and acidity in taste, it would probably arise through the nose independently of the power of smell. Snuff-takers are often devoid of smell; they lose the sense of sweet or repulsive in odours properly so called, but are still susceptible of the nicotine pungency. The influence flows through the same channel to the brain, and is of the same nature, as pricking the nose, or pulling out hairs, being conveyed by the nerves of common sensation.

The excitement of pungency is a characteristic variety of the human consciousness, a species of agreeable sensation interesting to study. It shows the effect of a sharp mechanical irritation of the nerves that does not amount to acute pain. A scratch, or a blow on the skin, an electric spark, a loud crash, a brilliant flame, a scorching heat, are all pungent effects, and seem to operate as causes of *excitement.* They rouse the system from ennui; they are a species of intoxication. They exalt, for the time being, the tone of the mind. They come therefore to be one of the cravings associated with ennui, or depression of mind; they are likewise a stimulus for bringing out the exuberance of the animal spirits in the young and vigorous.

13. The *ethereal* is a distinct variety of the sensations of smell, and is probably a mixture of pungency with odour strictly so-called. Alcohol and the ethers, including chloroform and the substance first employed as an anæsthetic, will recall this effect. There can be no question but that alcohol and the vinous aromas have true odours; most probably, however, they have an influence upon other nerves than the olfactory; just as the fiery taste attributed to them is something beyond the gustatory feeling. At all events the odour is distinct. It is not destitute of sweetness, but something besides sweet is wanted to express it.

The sulphurous and electrical odour, which is also the odour of ozone, may be referred to the same class.

If we were to recognize a class of *acrid* odours, they would only be a mixture of pungency and bad smell; like many of the so-called *empyreumatic* odours resulting from the action of heat on vegetable bodies, as in the manufacture of coal gas.

14. The *appetizing* smells might be treated as a class apart from the rest. The smell of flesh excites the carnivorous appetite, and rouses the animal to pursuit. We may probably consider this influence as similar in its working to the first taste of savoury food; by the law of feeling-prompted movement, it sets on the activity for an increase of the gratification. A savoury smell may partly give a commencing pleasure or digestion, and partly stimulate the appetite. The sexual excitement in some animals is induced by smell. Sympathy and antipathy are alike generated by odours. The influence of odours upon the voluptuous tender emotions has not escaped the notice of the poets. Cabanis observes that the odours of young animals are of a kind to attract, and, he considers, even to invigorate, the older.

15. Tastes, properly so called, affect only the gustatory nerves, and are therefore the same whether the nostrils are opened or closed. But many sapid bodies are also odorous.

In the act of expiration accompanying mastication, especially the instant after deglutition, the odorous particles are carried into the cavities of the nose, and affect the sense of smell, or make their odour apparent. This effect is what we term *flavour*. Some bodies, as cinnamon, have hardly any taste, but a flavour, in other words an odour, brought out by mastication.

16. Smell, like taste, is an important instrument in the discrimination of material bodies, and therefore serves a high function in guiding our actions and in extending our knowledge of the world. Man does not exemplify the highest development of this organ. The order of ruminants, certain of the pachydermatous animals, and above all the carnivorous quadrupeds, excel the human subject in the expansion given to the membrane of the nose, and in a corresponding sensibility to odours. The scent of the dog is to us almost miraculous; it directs his pursuit, and tells him his whereabouts. It may act the part of sight in enabling him to retrace his steps or to find out his master.

SENSE OF TOUCH.

1. Physiologists, in describing the senses, usually commence with Touch. 'This,' say Messrs. Todd and Bowman, 'is the simplest and most rudimentary of all the special senses, and may be considered as an exalted form of common sensation, from which it rises, by imperceptible gradations, to its state of highest development in some particular parts. It has its seat in the whole of the skin, and in certain mucous membranes, as that of the mouth, and is therefore the sense most generally diffused over the body. It is also that which exists most extensively in the animal kingdom; being, probably, never absent in any species. It is, besides, the earliest called into operation, and the least complicated in its impressions and mechanism.'

It may be well admitted that Touch is less complicated than Taste, in whose organ four different kinds of sensations may be said to meet, the tactile being one of them. It may be further said of touch, that the mode of action (mechanical contact or pressure), appears to us the most simple of any. Nevertheless, Touch is an intellectual sense of a far higher order than these. It is not merely a knowledge-giving sense, as they all are, but a source of ideas and conceptions of the kind that remain in the intellect and embrace the outer world. The notions of the size, shape, direction, distances, and situation of external bodies may be acquired by touch, but not by either taste or smell.

But this last assertion must be accompanied by an important explanation. Touch, considered as a source of ideas such as those, is really not a simple sense, but a compound of sense and motion; and it is to the muscular part of the sense, or to the movements of the touching organs, that these conceptions owe their origin and their embodiment, as we have endeavoured to show in the previous chapter. The superiority of touch to taste and smell, in this view, therefore, consists in its union with movement and muscular sensibility; and the same advantage pertains to sight. The contact of solid bodies with the surface of the body gives occasion to the exercise of movement, force, and resistance, and to the feelings and perceptions consequent on these: which cannot be said to any extent of smell, nor of taste properly so-called.

A second feature marking the superiority of the sense of Touch, and qualifying it to furnish intellectual forms and imagery, is the distinctness or separateness of the sensations felt over the different parts of the skin. The sensations of the different parts of the surface of smell, would seem all to fuse into one stream of sensibility; it is not possible ever to refer a smell to any one portion of the membrane more than another. But the sensations of the skin are conveyed by distinct nervous filaments; each little area of skin has a separate nerve, and an independent communication with the nerve centres, whereby we can, after a little education, refer each sensation to the spot where the contact is made. The stimulus on one finger is not, at any part of the course of the nerve, confounded with the stimulus on another finger; the back can always be distinguished from the breast, the right side from the left, and so on. I shall afterwards endeavour to show that this localization of touches has to be learned by practice; but the very possibility of it rests upon the distinctness and independence of the nerve filaments. This is an extremely important fact, and makes the great difference between touch and what is sometimes called 'common sensation,' or the sensibility diffused over all the internal organs and tissues. There is no such distinguishing sensibility in the stomach, or the lungs, or the liver; at all events, the distinctness of the nerves in those parts is very low in degree, just sufficient to enable us to refer a pain to the lungs, the liver, or the stomach, without indicating the particular region or sub-division. The skin is therefore marked by a great exaltation of the common sensibility of the body, not as regards intensity of feeling, but as regards distinctiveness of locality.

2. Having made these preliminary remarks, we commence as usual, with the *objects*, or external agents concerned in the sense of Touch. These are principally the *solid* substances of the outer world. Gases do not act on the touch unless they are blown with great violence. Liquids also give very little feeling, if they are of the same warmth as the body. The sensations of a bath are confined to heat or cold. It is manifest that an even, equal pressure, such as fluids give, is not sufficient to impress the tactile nerves. The asperities and inequalities of solid surfaces, by pressing intensely on some points and not at all on others, are requisite for this purpose.

The hard unyielding nature of the mineral constituents of the earth's crust, metals, rocks, &c., is well fitted to excite the touch. The woody fibre of the vegetable world has a compactness next in degree to the solid minerals. The soft and yielding class of solids impress the surface in a totally different manner: and these differ among themselves according as they recover their form after pressure, or not; whence the distinction of elastic and non-elastic. When the substance is moved over the skin, the asperities come to be felt more acutely, and hence the further distinction into rough and smooth surfaces. In treating of the sensations themselves, we shall attend to these qualities more minutely.

3. The *sensitive organ* or surface is the Skin, or common integument of the body, the interior of the mouth, and the tongue. The parts of the Skin are its two layers, its papillæ, the hairs and nails, its two species of glands,—the one yielding sweat, the other a fatty secretion,—with blood vessels and nerves. I shall quote a few extracts from the anatomical description of those parts. Of the two layers, the outermost is the *cuticle, epidermis,* or *scarf skin.* 'It forms a protective covering over every part of the true skin, and is itself quite insensible and non-vascular. The thickness of the cuticle varies in different parts of the surface, measuring in some not more than $\frac{1}{240}$, and in others from $\frac{1}{24}$ to $\frac{1}{12}$ of an inch. It is thickest in the palms of the hands and soles of the feet, where the skin is much exposed to pressure, and it is not improbable that this may serve to stimulate the subjacent true skin to a more active formation of epidermis; but the difference does not depend solely on external causes, for it is well marked in the fœtus.

'Many of the cells of the cuticle contain pigment, and often give the membrane more or less of a tawny colour, even in the white races of mankind; the blackness of the skin in the negro depends entirely on the cuticle. The pigment is contained principally in the cells of the deep layer, and appears to fade as they approach the surface, but even the superficial part possesses a certain degree of colour.

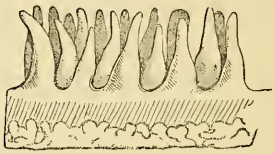
'The *true skin*, *cutis vera*, *derma*, or *corium*, is a sentient and vascular texture. It is covered and defended by the insensible and non-vascular cuticle, and is attached to the parts beneath by a layer of cellular tissue, named "subcutaneous," which, excepting in a few parts, contains fat, and has therefore been called also the "panniculus adiposus."

The connexion is in many parts loose and movable, in others close and firm, as in the palmar surface of the hand and the sole of the foot, where the skin is fixed to the subjacent fasciæ by numerous stout fibrous bands, the space between being filled with a firm padding of fat. In some regions of the body, the skin is moved by muscular fibres, which, as in the case of the orbicular muscle of the mouth, may be unconnected to fixed parts, or may be attached beneath to bones or fasciæ, like the other cutaneous muscles of the face and neck, and the short palmar muscle of the hand.'

The upper or free surface of the true skin 'is marked in various places with larger or smaller furrows, which also affect the superjacent cuticle. The larger of them are seen opposite the flexures of the joints, as those so well known in the palm of the hand and at the joints of the fingers. The finer furrows intersect each other at various angles, and may be seen almost all over the surface; they are very conspicuous on the back of the hands. These furrows are not merely the consequence of the frequent folding of the skin by the action of muscles or the bending of joints, for they exist in the fœtus. The wrinkles of old persons are of a different nature, and are caused by the wasting of the soft parts which the skin covers. Fine curvilinear ridges, with intervening furrows, mark the skin of the palm and sole; these are caused by ranges of the papillæ, to be immediately described.'

'*Papillæ.*—The free surface of the corium is beset with small eminences thus named, which seem chiefly intended to contribute to the perfection of the skin as an organ of touch, seeing that they are highly developed where the sense of touch is exquisite, and *vice versâ.* They serve also to extend the surface for the production of the cuticular tissue, and hence are large-sized and numerous under the nail. The papillæ are large, and in close array on the palm and palmar surface of the fingers, and on the corresponding parts of the foot. There they are ranged in lines forming the curvilinear ridges seen when the skin is still covered with its thick epidermis. They are of a conical figure, round or blunted at the top, and are received into corresponding pits on the under surface of the cuticle. They measure on the hand from $\frac{1}{200}$ to $\frac{1}{100}$ of an inch in height. In the ridges, the large papillæ are placed sometimes in single, but more commonly in double rows, with smaller ones between them, that is, also on the ridges, for there are none in the intervening grooves. These ridges are marked at short and tolerably equal intervals with notches, or short transverse furrows, in each of which, about its middle, is the minute funnel-shaped orifice of the duct of a sweat gland. Fine blood-vessels enter the papillæ, forming either simple capillary loops in each, or dividing, according to the size of the papillæ, into two or more capillary branches, which turn round in form of loops, and return to the veins. Filaments of nerves are also to be discovered ascending into the papillæ, but their mode of termination is doubtful. In other parts of the skin, endowed with less sensibility, the papillæ are smaller, shorter, fewer in number, and irregularly scattered. In parts where they are naturally small, they often become enlarged by chronic inflammation round the margin of sores and ulcers of long standing, and are then much more conspicuous.'—QUAIN.†

Fig. 6.*



* 'Papillæ of the palm, the cuticle being detached.—Magnified 35 diameters.'—(TODD and BOWMAN.)

† Inside the papillæ are either nerves or blood vessels, seldom both; and at their base, the nerves are disposed in the form of net-work. In great part of the skin, the nerves cannot be traced farther than this net-work; it is in the hands, feet, lips (red part), and tongue that they are followed into the interior of the papillæ. In these parts they end in a peculiar structure, known as the 'little bodies of touch,' discovered by Wagner and Meissner. These are little sacks, covered by a thin skin, and filled with a round little mass. The skin is pierced by one or two nerves, which often wind spirally, but end by dividing and spreading their twigs in the little sack. These bodies lie in the interior of papillæ destitute of blood vessels, in such a manner as to project far above the upper end of the papillæ, and in immediate contact with

I have quoted the description of the papillæ at length because of their connexion with the sensibility of the skin. I shall refrain from quoting the minute account of the nails and hairs, however interesting their structure in other points of view. Respecting the glands, it is only necessary to advert to the totally different nature of the two sorts, as respects the material secreted. The *sweat* glands are enormously numerous, and exist in all regions of the skin; they are reckoned to vary from 400 to 2,800 in a square inch. 'The *sebaceous* or oil glands pour out their secretions at the roots of the hairs, for, with very few isolated exceptions, they open into the hair follicules, and are found wherever there are hairs.'

4. With respect to the functions and vital properties of the skin in general, I quote part of Dr. Sharpey's summary.

'The skin forms a general external tegument to the body, defining the surface, and coming into relation with foreign matters externally, as the mucous membrane, with which it is continuous and in many respects analogous, does internally. It is also a vast emunctory, by which a large amount of fluid is eliminated from the system, in this also resembling certain parts of the mucous membrane. Under certain conditions, moreover, it performs the office of an absorbing surface; but this function is greatly restricted by the epidermis. Throughout its whole extent the skin is endowed with *tactile sensibility*, but in very different degrees in different parts. On the skin of the palm and fingers, which is largely supplied with nerves and furnished with numerous prominent papillæ, the sense

the cuticle. They are most numerous on the inside of the finger tips, and decrease towards the palm; the same happens with the foot. Meissner found in a square line ($\frac{1}{144}$ of a square inch) on the index finger, 108 on the last joint, 40 on the second, 15 on the first. In the red part of the lips, the papillæ carrying nerves are not distinguishable from those carrying blood vessels, the same papilla appearing to have both.

The little muscles discovered by Kölliker in the skin, and especially in the glands, excite peculiar movements as in shivering, the creeping sensation, &c. These are especially affected by changes of temperature, and may serve to regulate the supply of blood under such changes.

attains a high degree of acuteness; and this endowment, together with other conformable arrangements and adaptations, invests the human hand with the character of a special organ of touch. A certain, though low degree of vital contractility, seems also to belong to the skin.'—QUAIN.

Of the other parts sensible to Touch, besides the skin, namely, the tongue and mouth, the needful description has been already furnished under the sense of Taste.

The nerves of touch are the sensory or posterior roots of the spinal nerves for the limbs and trunk, and certain of the cerebral nerves (the fifth pair) for the head, face, mouth, and tongue.*

5. The *action* in touch is known to be simple pressure. The contact of an object compresses the skin, and through it the embedded nerve filaments. That the squeezing or pinching of a nerve can produce sensibility is proved in many experiments: in touch, the squeezing is of a more gentle nature, owing to the protection that the covering of skin gives to the nerves. The only point of interest connected with the mode of action is the singular fact, that very light contacts often produce a great sensibility, as the touch of a feather or of a loose hanging piece of dress, which sensibility is diminished by making the contact more intense. Great pressures yield comparatively little sensation in the skin; they are felt mainly in the muscles as a feeling of force and resistance.

This fact of the disproportion of the feeling to the pressure I can account for in no other way than by supposing, that great compression has an effect in deadening the conducting property of the nerve. We know from various observations that the compression of a nerve does tend to arrest its conductibility; the deadening of the sensibility of the hand by leaning the elbow on a table, so as to squeeze the nerve that

* It is supposed that the important nerves of touch in the extremities have a different course in the brain from the nerves of the trunk. Türk has shown that in the hand and foot the same spot is supplied from different roots in the spinal cord.

passes near the surface on the elbow joint, is a familiar instance.

6. We come now to the *sensations*, or feelings of touch, which are various in kind, and have many of them a considerable degree of interest, from their bearing on the higher operations of mind. In the order of enumeration, I shall commence as usual (I.) with those having reference to pleasure or pain, or that may be called predominantly emotional.

Sensations of Soft Touch.—In this class of feelings, we suppose the gentle contact of some extended surface with the skin. I keep out of view the feeling of temperature. A good example is furnished by the contact of the under clothing with the general surface of the body, which is most perfect under the bed-clothes at night. The glove not too tight on the hand is another instance. The extended hand, resting on a cushion, or other soft body, is a sufficiently good type of the situation.

The resulting sensation is of the pleasurable kind, not acute, but massive. It closely resembles agreeable warmth. It is less powerful, but probably more retainable in idea, than the muscular or the digestive sensibilities. Its relationship tc the tender emotion is elsewhere discussed. (THE EMOTIONS AND THE WILL, *Tender Emotion.*)

The habitual inattention to the sensibility of the clothing is a striking example of the law of Relativity. The remission of the contact is felt, on the same principle, as a sensation of blankness.

In the feelings of the lachrymal, mammary, and sexual organs, the mode of action appears to be something more than simple contact; the quality of the touching substance affects the sensation. In the tranquil flow of the lachrymal fluid, under genial tender emotion, there is a certain amount of agreeable sensation in the eye; but when the eyes are flooded in profuse grief, the contact of the liquid with the eye-lids is scarcely pleasurable. There is probably, if not a chemical, at least a dialytical action on the sensitive surfaces, in those instances.

The mutual contact of living animal bodies yields a complex sensation of softness and warmth, and excites the corresponding emotions. There may be, in addition, magnetic or electric influences of a genial kind, but the reality of such currents is by no means established.

The attraction between the mother and offspring is partly grounded upon the pleasure of the soft warm contact. This keeps the new-born animal by the mother's side, before it has come under the farther gratification of being fed and nourished; and continues to co-operate with that still more powerful motive to close proximity. At a later period, the contact of the opposite sexes, stimulated, in the first instance, by the pleasure of mere touch, discloses and inspires in each the sexual urgencies, and the tentatives for gratifying them.

Many of the habitual attitudes and modes of outward expression are regulated by the pleasure of soft touch. The child puts its finger or hand to its mouth, either for the mere pleasure of the act, or as a comforting sensation in distress; and all through life the contact of the hand with the parts of the face is practised from the same motives. Many other attitudes and actions are governed by the pleasures of touch; some, as scratching the head, are apparently the search for pungency.

7. *Pungent and painful Sensations of Touch.*—When, instead of a diffusive soft contact, we have an intense action on limited spots, mere points, as in the stroke of a whip, a sensation of smartness is produced very different from the above. In moderate degree, this gives a pleasurable pungency, beyond which it is acutely painful. The nerves are shocked as by the prick of an instrument, and the over-intensity and suddenness of the stimulus is a cause of pain. The nature of the sensation is not radically different from a cut in the skin; its peculiar smartness excites the whole system. It prompts the most decisive actions for avoiding the pain, and an intense mental aversion to all that relates to it. The intensity gives to it a hold on the memory not possessed by the luxurious feeling of diffused softness.

Hence the efficacy of skin inflictions in the discipline of sensitive beings.

Other things being the same, the sensibility of the skin to these two classes of feelings is greatest in parts most richly supplied with nerves, and where the discriminative or tactile sensibility is greatest, as in the tongue, the lips, and the palm of the hand.

8. *Other painful Sensations of the Skin.*—Among these I would first advert to the sensation of tickling. On this Weber remarks, that the lips, the walls of the nasal openings, and the face generally, when touched with a feather, give the peculiar sensation of tickling, which continues till the part is rubbed by the hand. In the nose, the irritation leads at last to sneezing. The excitation extends to the ducts of the glands, which pour out their contents, and increase the irritation. The violent commotion produced by bodies in contact with the eye, is of the nature of tickling, accompanied by a flow from the glands, and readily passing into pain. Why some places are liable to this sensation, and others not, it is difficult to explain. The possession of delicate tactual discrimination is not necessary to the effect.

The singularity of tickling is the fact that a very trifling sensation prompts to extraordinary efforts of the will for deliverance. The tickling of the arm-pit, or the soles of a susceptible person, is as violently repudiated as the touch of a scalding surface.

There is one consideration that may help to account for the anomaly. It is the nature of tickling to stimulate intense reflex movements; these are, on their own account, a source of massive discomfort and repugnance. The same tactile feeling, if unaccompanied with reflex stimulation, might be wholly indifferent. This remark may apply to the tickling that precedes laughing and sneezing. The irritation of the fauces brings about, in the first instance, reflex contractions of the muscles of the throat; these are more or less acutely painful; thereupon, we give way to the farther impulse to spasmodic expiration.

Possibly the same explanation may be extended to the chafing and fretting of the skin, when too slight to be painful as a pungent smart. A reflex stimulus is applied when the nervous system is irritable, and when forced muscular movements would be painful and repugnant. It is not the sensation by itself that we dread, but the wakening up of activity when we are courting repose and quiescence.

All the parts of the skin are liable to yield painful sensations, especially under injury or distemper. The epidermis is itself insensible, but the true skin is extremely alive to feeling. When lacerated, chafed, or burnt, it causes acute pains. Its capillary vessels and numerous sweat glands and oil glands are, in all probability, the source of pleasurable or painful organic sensations. The long continued compression of the same part of the skin creates uneasiness. The hairs are themselves insensible, but by their attachment to the skin they are the media of sensation. The place of attachment of the nails is the seat of a violent form of acute pain, which has a facility of seizing on the imagination, and of exciting revulsion even in idea.

Clamminess is a distinct sensation arising from the adhesion of a substance to the skin, and is an uneasy feeling, the uneasiness being due to some interruption of the natural functions of the part.

9. (II.) *Sensations of Temperature.*—The feelings of heat and cold are most powerfully felt in the skin ; the sensitiveness also extending to the gullet, the stomach, and the rectum. There is no reason for supposing that any other nerves than those of touch are needed to a rouse a sensation of warmth or of coolness. As to the mode of action, heat being a state of molecular motion will impart molecular disturbance to the nerves, and thus operate as a stimulant, favourably or unfavourably according to the circumstances.*

* Sir William Hamilton thinks it probable that the sensation of heat depends on a peculiar set of nerves, for two reasons : '1st, Because certain sentient parts of the body are insensible to this feeling ; and, 2nd, Because I have met with cases recorded, in which, while sensibility in general was

The sensation of wetness seems to be nothing else than a form of cold.

As regards the discrimination of degrees of Temperature, it appears that we are equally sensitive at high and at low points of the thermometer. According to Weber, we can discriminate 14° Reaumur from 14.4°, as well as 30° from 30.4°; and the discrimination is all the better by the change being rapidly made. It is also better when the unequal temperatures are applied at the same time to contiguous parts, than when the parts touched are remote from each other. The sensitiveness of different parts to temperature is not solely dependent on the abundance of nerves supplied to the part; some other circumstance at present unknown is in operation. Weber's graduated scale for heat is as follows:—tip of the tongue, eyelids, lips, neck, trunk. In the face, breast, and abdomen, the central parts are less sensitive than the sides.

The sensitiveness is increased by extent of surface. In an experiment with dipping the finger into water at 32° R., and the whole hand in 29½°, the latter appeared the warmer of the two.

It is remarked that when one part of the body touches another, the temperature being the same, the part endowed with the finer tactile power feels the other. If the tempera-

abolished, the sensibility to heat remained apparently undiminished.'—Reid, p. 875.

On the other hand, the experiments of Weber, while leading to the conclusion that the integrity of the skin is necessary to the discrimination of degrees of temperature by touch, give no ground for supposing that any other nerve fibres than those of common tactile sensation are necessary.—Carpenter's *Human Physiology*, 4th edition, § 866.

Brown-Séquard is, however, of opinion that, in the spinal cord, the channel for conducting impressions of temperature is different from that for tactile impressions.

It may be remarked that the discriminative sensibility of the skin, shown in the feeling of plurality of impressions, implies an internal or central organization for receiving, independently, the stimuli of the different parts. Now, an internal derangement might vitiate this independent conveyance of impressions without destroying the sensibility of the fibres to the impulses of heat, or cold, or other strong irritation. It has been stated that when the thalami optici are injured, tactile sensation is lost, but not the sensibility to pain.

tures are different, the first feels the second tactually, while the second feels the temperature of the first. The hand is not felt tactually by the brow, nor is the coldness of the brow felt by the hand.

It is a singular fact, discovered by Weber, in connexion with the sense of temperature, that when two substances of the same weight, but of different temperatures, are estimated by the sense of touch or of pressure, the colder appears the heavier. The depressing effect of the cold chill upon the mind may be the explanation. This is somewhat analogous to the perversion of our estimate of time by an unusual elation or depression of the general mental tone: in the one case we imagine it to pass rapidly, in the other slowly.

The feeling of temperature is an element in many discriminations, as in the distinction between stone and wood.

We pass now (III.) to the most intellectual sensations of Touch, and first to cases of Touch simply.

10. (1.) *Impressions of distinguishable Points.*—I have already called attention to the discriminative or articulate character of the sense of touch, whereby it receives distinguishable impressions from the variously situated parts of an extended surface. Very interesting differences in the degree of this discrimination are observable on different parts of the surface of the body, which have been especially illustrated by the experiments of Weber.

'These consisted in placing the two points of a pair of compasses, blunted with sealing wax, at different distances asunder, and in various directions, upon different parts of the skin of an individual. It was then found, that the smallest distance at which the contact can be distinguished to be double, varies in different parts between the thirty-sixth of an inch and three inches; and this seems a happy criterion of the acuteness of the sense. We recognize a double impression on very sensible parts of the skin, though the points are very near each other; while, in parts of less acute sensibility, the impression is of a single point, although they may be, in reality, far asunder.

'In many parts we perceive the distance and situation of two points more distinctly when placed transversely, than when placed longitudinally, and *vice versâ*. For example, in the middle of the arm or fore-arm, points are separately felt at a distance of two inches, if placed crosswise; but scarcely so at the distance of three, if directed lengthwise to the limb.

'Two points, at a fixed distance apart, feel as if more widely separated when placed on a very sensitive part, than when touching a surface of blunter sensibility. This may be easily shown by drawing them over regions differently endowed; they will seem to open as they approach the parts acutely sensible, and *vice versâ*.

'If contact be more forcibly made by one of the points than by the other, the feebler ceases to be distinguished; the stronger impression having a tendency to obscure the weaker, in proportion to its excess of intensity.

'Two points, at a fixed distance, are distinguished more clearly when brought into contact with surfaces varying in structure and use, than when applied to the same surface, as, for example, on the internal and external surface of the lips, or the front and back of the finger.

'Of the extremities, the least sensitive parts are the middle regions of the chief segments, as in the middle of the arm, fore-arm, thigh, and leg. The convexities of the joints are more sensible than the concavities.

'The hand and foot greatly excel the arm and leg, and the hand the foot. The palms and soles respectively excel the opposite surfaces, which last are even surpassed by the lower parts of the fore-arm and leg. On the palmar aspect of the hand, the acuteness of the sense corresponds very accurately with the development of the rows of papillæ; and where these papillæ are almost wanting, as opposite the flexions of the joints, it is feeble.

'The scalp has a blunter sensibility than any other part of the head, and the neck does not even equal the scalp. The skin of the face is more and more sensible as we approach the middle line; and the tip of the nose and red parts of the lips are acutely so, and only inferior to the tip of the tongue. This last, in a space of a few square lines (a line is $\frac{1}{12}$ of an inch), exceeds the most sensitive parts of the fingers; and points of contact with it may be generally perceived distinctly from one another, when only one-third of a line intervenes between them. [The superior sensibility of the tip of the tongue to the finger, is illustrated by the familiar observation, that a hole in a tooth seems very much exaggerated when felt by the tip of the tongue.] As we recede from the tip along the back or sides of the tongue, we find the sense of touch much duller.

'The sensibility of the surface of the trunk is inferior to that of the extremities or head. The flanks and nipples, which are so sensitive to tickling, are comparatively blunt in regard to the appreciation of the distance between points of contact. Points placed on opposite sides of the middle line, either before or behind, are better distinguished than when both are on the same side.

'The above are the results obtained by making the several parts mere passive and motionless recipients of impressions. They evince the precision of the sense in so far only as it depends on the organization of the tactile surface. The augmented power derived from change of position of the object with regard to the surface, is well illustrated by keeping the hand passive, while the object is made to move rapidly over it. In this case the contact of the two points is separately perceived, when so close that they would, if stationary, seem as one. If, still further, the fingers be made to freely traverse the surface of an object, under the guidance of the mind, the appreciation of contact will be far more exquisite, in proportion to the variety of the movements, and the attention given to them. We are then said to *feel*, or to examine by the sense of touch.'—TODD and BOWMAN, I., 429-30.

These observations of Weber have been deservedly celebrated by physiologists, as the foundation of an accurate mode of estimating the tactile sensibility of the skin. They have been extended by other observers, as may be seen in Dr. Carpenter's article on Touch in the *Cyclopædia of Anatomy.** It is necessary, however, for us to discuss more closely the matters involved in them, and especially to discriminate the tactile from the muscular element of the sensations.

Whenever two points produce a double sensation, we may imagine that one point lies on the area supplied by one distinct nerve, while the other point lies on the area of a second nerve. There is a certain stage of subdivision or branching of the nerves of touch, beyond which the impressions are fused into one on reaching the cerebrum. How many ultimate nerve fibres are contained in each unit nerve, we cannot pretend to guess; but on the skin of the back, the middle of

* The following are a selection from Weber's measurements. The intervals are expressed in lines, a line being the twelfth part of an inch. The range according to Weber is from the twenty-fourth of an inch, in the tip of the tongue, to two and a-half inches. The range stated in the text is somewhat greater, being founded probably on a comparison of the extreme observations of different observers:—

Tip of the tongue, ...	$\frac{1}{2}$	of a line ($\frac{1}{24}$ of an inch).
Tip of the forefinger, palmar surface, ...	1	„
Red surface of under lip, ...	2	„
Second joint of the fingers, palmar surface, ...	2	„
Last joint of the fingers, back or dorsal surface, ...	3	„
Tip of the nose, ...	3	„
Middle of the back of the tongue, ...	4	„
End of the great toe, ...	5	„
Palm of the hand, ...	5	„
Cheek, over the buccinator, ...	5	„
Lower part of the forehead,..	10	„
Back of the hand, ...	14	„
Crown of the head, ...	15	„
Thigh, by the knee, ...	16	„
Upper and lower extremities of the legs, ...	18	„
Breast, ...	20	„
Back of neck near occiput, ...	24	„
Middle of fore-arm, middle of thigh, middle of the back of the neck, middle of the back, ...	30	„

If the points are placed within the limit of doubleness and gradually separated, the interval that gives doubleness is greater than in the reverse process.

the thigh, and the middle of the fore-arm, an area of three inches diameter, or between six and seven square inches, is supplied by the filaments of a single unit. On the point of the finger, the units are so multiplied, that each supplies no more than a space whose diameter is the tenth of an inch. Such units would correspond to the entire body of the olfactory or gustatory nerve, for these nerves gives but one undivided impression for the whole area affected; or at most would give two impressions, one for each side.

It is important to observe that the primitive susceptibility to a plurality of distinct points, does not enable us to judge what the real distance of the points is; nor can we tell previous to experience whereabouts on the body the impression is made. Hence in those of the experiments that relate to our sense of the relative interval of the points, as when they pass from a duller to a more sensitive region, there are involved perceptions that we have got at in some other way than through the sense of contact. This other means is the feeling of movement or the muscular sensibility, without which it is impossible to comprehend fully the sensations of Touch.

11. (2.) *Sensations of Pressure.*—When a contact passes from the soft touch to a certain amount of energy of compression, the character of the sensation is entirely changed. It becomes indifferent as regards pleasure and pain, unless the pressure is on the verge of injuring the parts, when it becomes painful. The nerves of touch are of course affected, but probably not they alone. The compression may extend its influence to the nerves in the deep seated parts, that is, to fibres supplied to muscles, &c.

If the compressed limb is unsupported, its muscles re-act and give the feeling of resistance. If it is supported, as when the hand lies on the table, the effect is one of pressure solely, whether the nerves stimulated are those of the skin alone or of the skin and the interior tissues combined. The sense of pressure is found to have a certain power of discrimination, applicable to determine degrees of weight, hardness, elasticity, and other properties. The most sensitive parts, as the tips of the fingers, can distinguish 20 oz. from 19·2 oz.; the forearm distinguishes 20 oz. from 18·7 oz. The interval of time affects the discrimination, as we might suppose. The difference between 14, or even 14·5, could be distinguished from 15, within 30 seconds; 4 and 5 could be distinguished within 90 seconds.

The discrimination of pressure does not increase proportionably with the supply of tactile nerves.

12. (IV.) *Sensations of Touch involving muscular perceptions.*—In discussing these, we shall begin with examples that are almost purely muscular, the tactile sensibility being a mere incident of the situation. The feeling of *weight* is of this description; depending on the sense of muscular exertion, although capable also of being estimated to some extent by the feeling of compression of the skin. On this last point, I add some further illustrations from Messrs. Todd and Bowman. 'Weber performed experiments to ascertain how far we are capable of judging of weight by the mere sense of contact [without muscularity]. He found that when two equal weights, every way similar, are placed on corresponding parts of the skin, we may add to, or subtract from one of them a certain quantity without the person being able to appreciate the change; and that when the parts bearing the weights, as the hands, are inactively resting upon a table, a much greater alteration may be made in the relative amount of the weights without his perceiving it, than when the same parts are allowed free motion. For example, 32 ounces may thus be altered by from 8 to 12, when the hand is motionless and supported; but only by from $1\frac{1}{2}$ to 4, when the muscles are in action; and this difference is in spite of the greater surface affected (by the counter pressure against the support) in the former than in the latter case. Weber infers that the measure of weight by the mere touch of the skin is more than doubled by the play of the muscles. We believe this estimate to be rather under than over the mark.'—p. 431.

That the discriminating sensibility of the skin to degrees of compression may operate in appreciating weight is further confirmed by the following statement. 'The relative power of different parts to estimate weight corresponds very nearly with their relative capacities of touch. Weber discovered that the lips are better estimators of weight than any other part, as we might have anticipated by their delicate sense of touch and *their extreme mobility.* The fingers and toes are also very delicate instruments of this description. The palms and soles possess this power in a very remarkable degree, especially over the heads of the metacarpal and metatarsal bones; while the back, occiput, thorax, abdomen, shoulders, arms, and legs, have very little capacity of estimating weight.'—*ib.* p. 432.

What is said of weight applies to any other form of *pressure, force,* or *resistance.* The impetus of a push or a squeeze received on the hand is measured by the muscular exertion induced to meet it, and in some small degree, as above described, by the compression of the skin and other parts at the place of contact.

It must not be supposed that we could derive our original feeling of RESISTANCE, with its reference to the object world, by mere tactile sensibility through pressure. The sense of resistance is primarily the feeling of expended energy. When the notion is once formed, we can remark that the degrees of resistance coincide with degrees of the tactile sensibility to pressure; and hence the passive feeling can suggest the active, and become a criterion of its amount.

The qualities of *hardness* and *softness* are appreciated by this combined sensibility; the one means a greater resistance to compression, and the other a less. From the unyielding stone or metal to the mobility of the liquid state, we have all degrees of this property; the entire class of soft, viscous, and fibrous substances lying between. It belongs to many of the manual arts to appreciate minute differences of consistence in the class of soft bodies; the pastry-cook, the builder, the sculptor, &c. In this they are assisted by practice, which improves all sensibilities: but there are great varieties of natural endowment in the case, which varieties must have their seat principally in the muscular tissue, and only secondarily in the skin and nerves of the hand.

The feeling of *elasticity* is only a case of simple resistance to force, exerted in the particular circumstance of a rebound or increasing reaction from pressure. The elasticity implies a perfect return to the original position ; air is elastic, and so is steel and ivory, meaning that when in any way compressed or distorted, they recover themselves.

We may next consider the sensations rising out of the qualities of *roughness* and *smoothness.* Simple contact, we have seen, gives the sense of a multiplicity of points. The finger resting on the end of a brush would make us aware of its character; that is, we should have the feeling of a plurality of pricks. In this way, we are sensitive to rough and pointed surfaces. We can distinguish between bluntly-pointed asperities, like a file, and sharp points, like a horse-comb : the sensibility of a blunt point being distinct from a needle-prick. We can also distinguish between thick-set points and such as are more scattered, provided they are not too close for the limits of sensibility of the part, that is to say, one-twelfth of an inch for the finger, and one twenty-fourth to one-thirtieth for the tip of the tongue. On the back, the calf of the leg, and the middle of the fore-arm, where points are confounded up to the distance of two and a half to three inches, roughness would be altogether imperceptible.

In these instances, the thing touched is supposed to lie at rest on the finger, or on the part touched. But this does not do full justice to the tactile sensibility ; we should move the finger to and fro over the surface, in order to try to the utmost the power of discrimination. We may thus discriminate far nicer shades of roughness ; we may appreciate minuter intervals than in the resting position. Supposing the sensibility of the tip of the finger at rest to be one line, by motion we can extend this sensibility to an unknown limit. The case may be illustrated by the micrometer screw on an astronomical instrument. The divisions on the limb of the instrument extend, we may suppose, to one minute of a degree, and if the index lie between two divisions, its place can be measured by the number of turns of the screw required to bring it up to one of the divisions. So, if a point is undistinguished on the finger, in consequence of not being a line removed from the neighbouring point, we may estimate its distance, nevertheless, by the amount of motion of the finger needed to bring it into the limit of sensibility. I will take as an example a row of five points, one-fortieth of an inch apart, the extremes being one-tenth, which is the sensibility of the tip of the finger. This row would be felt as two points if the finger were stationary. But by the motion of the finger one point would pass away and another would come up, and there would be a feeling of the interval moved over between the perception of the successive points, which would be a measure of the intervals. The sense of movement would thus be brought in to aid the tactile feeling, and to reveal a degree of closeness in asperities beyond the reach of touch unassisted by motion. It is consistent with all experience, that the roughness of a surface becomes far more apparent by drawing the hand over it. We must, however, farther consider that friction creates a new variety of pressure on the skin and nerves; and the kind of friction is so different for a smooth and for a rough body, that by it alone we might learn to distinguish between the rough and the smooth contact.

If any one will make the experiment of drawing over the finger two points, so close that to the touch they seem one when at rest, it will be found that the motion gives the feeling of doubleness. What is the limit of this (for a limit there is) it would take a considerable amount of observation to decide. I venture to affirm that at least half the interval will become sensible by the motion of the points, the motion being by bringing them in train, and not abreast of one another.

Whatever may be the explanation of the increase of sensibility due to movement, the fact is an important one. A large amount of discrimination turns upon it. From the variety of trace made by different kinds of surface, we can distinguish them or identify them at pleasure, up to a considerable limit of delicacy. Hence the power of telling substances by the touch, and of deciding on the qualities and merits of texture and of workmanship. Degrees of polish in stone, metal, or wood, the fineness of cloths, wool, &c., the beat of a pulse, the quality of powdered substances, and many things besides, are matters of judgment and comparison to the touch, and put to the proof its natural or acquired delicacy.

These tactile sensations whereby surfaces are discriminated, have a great degree of persistence in the recollection; something intermediate between tastes or smells, and sights. We do not revel in them as imagery, it is true, but this would be accounted for by the superior hold that we have of the very same objects by means of sight. With the blind, the case is different; to them the outer world must be represented as outspread matters of contact; their visions of the surfaces of all things are visions of touch.

Our permanent impressions of touch serve us for comparing present surfaces with remembered ones, and for identifying or distinguishing the successive objects that come before the view. The cloth dealer sees whether a given specimen corresponds with another piece that passed through his hands a week ago, or with a permanent standard impressed upon his finger sensibility.

13. *Qualities of Extension, Size, Form, &c.*—I have endeavoured to show in the previous chapter, that these qualities are impressed upon us by the movements they cause, and that the feelings they produce are feelings of movement or muscularity. It is now to be seen how far the sense of Touch proper enters into our notions of the fundamental property of the object world, namely EXTENSION, of which Distance, Direction, Position, and Form are only special modes or applications.

When we examine closely the sensibilities obtained by movement alone, as by passing the arm to and fro in empty space, we find that these have various shortcomings as regards the idea of extended matter, or extended space.

In the first place, the absence of some definite marks, to indicate the commencement and the termination of a muscular sweep, leaves a certain vagueness in our feeling of mere movement. The feelings of putting forth power, and of this power taking the form of movement as distinct from dead strain, are present in all cases; but the mind is more alive to them when some definite impression marks where we begin and where we cease. Now, the sense of touch supplies this impression, and furnishes, as it were, a call to attention. Let us suppose the hand moving between two fixed obstacles, for example, from one side of a box to another. There is, to commence with, the contact with one side of the box felt more or less as a sense of touch, pressure, and resistance (a feeling partly muscular, but this need not be considered); the abrupt departure from this state is a mark in consciousness, a call to attention; and the mind is awakened to the feeling of movement that follows. After a time, the other side is struck, and the mind is again roused, and takes note of the cessation of the movement. The antithesis of resisting matter and unresisted movement is well brought out by such an experience; there is in it something more than the contrast of the swing of a limb with its undisturbed quiescence, which is all that movement *in vacuo* can give us.

In the next place, when the hand is moved over a surface, touching it the while, the feeling of continuance of movement is accompanied by a feeling of continuance of tactile sensation, making the consciousness more marked and acute, and so enabling us to estimate the degree of continuance more nicely. A feeling of the subject (touch proper) is superadded to the great object sensibility (expended energy as movement), and deepens the impress of that sensibility, without being able to take its place, or to constitute the feeling of objectivity. The peculiar tactile sensation that friction causes, is thus a means of suggesting extension and of estimating it, although incompetent to supply the notion itself.

In the third place, movement *in vacuo* seems unable to indicate that distinction between Succession and Co-existence —Time and Space—which must be arrived at before we can say that we recognize Extension. The continuance of movement is a fact that we are conscious of; in other words, we are conscious of a peculiar mode of the putting forth of energy which varies in degree, and we remark one movement as different from another on this point. But if any property of *things* is indicated by this, it would seem to be not space, but time. In truth, neither is known, for they are a correlative couple, not known at all till they are known together.

Now, we are able to show, how the embodying of our movements in sensation enables us to distinguish between the two facts or properties, called the Co-existing and the Successive.

When, with the hand, we grasp something moving, and move with it, we have a sensation of one unchanged contact and pressure, and the sensation is imbedded in a movement. This is one experience. When we move the hand over a fixed surface, we have, with the feelings of movement, a *succession* of feelings of touch; if the surface is a variable one, the sensations are constantly changing, so that we can be under no mistake as to our passing through a series of tactile impressions. This is another experience, and differs from the first, not in the sense of power, but in the tactile accompaniment. The difference, however, is of vital importance. In the one case, we have an object moving, and measuring *time* or continuance; in the other case, we have co-existence in *space*. The co-existence is still farther made apparent by our reversing the movement, and thereby encountering the tactile series in the inverse order. Moreover, the serial order is unchanged by the rapidity of our own movements. A more rapid pass of the hand makes the series come up quicker; a less rapid, brings the same series in more slowly. By these experiences, we gradually become aware of a wide distinction between identical movements conducted under such different circumstances; and the distinction is expressed in language, as succession and co-existence—time and space. Succession is the simplest fact; an unvarying contact accompanied with a movement, is enough for that. But co-existence is highly complex. The chief points involved in it are those now mentioned,—a series of contacts, and the inversion of the series by an inverted movement. The repetition of these, with the same mental effects, constitutes that notion of permanence, or of fixity of arrangements, implied in the object world, the universe as co-existing in Space.*

By drawing the hand over a surface, as, for example, twelve inches of wire, we have an impression of the quality of the surface, and also of its length. On transferring the hand to another wire thirty-six inches long, the increased sweep necessary to reach the extremity, is the feeling and the measure of the increased extent. By practising the arm upon this last wire, we should at last have a fixed impression of the sweep necessary for a yard of length, so that we could say of any extended thing, whether it was within or beyond this standard. Nay more, whenever anything brought up a yard to our recollection, the material of the recollection would be an arm impression, just as the material of the recollection of greenness is a visual impression.

If we pass from length to two dimensions, as, for example, the *surface* of a pane of glass, we have only a greater complexity of movement and of the corresponding impression. Moving in one direction we get the length; in the cross direc-

* Mr. Herbert Spencer has analyzed the relation of co-existence and sequence with great clearness and felicity. He remarks:—'It is the peculiarity alike of every tactual and visual series which enters into the genesis of these ideas, that not only does it admit of being transformed into a composite state, in which the successive positions become simultaneous positions, but it admits of being reversed. The chain of states of consciousness, A to Z, produced by the motion of a limb, or of something over the skin, or of the eye along the outline of an object, may with equal facility be gone through from Z to A. Unlike those states of consciousness constituting our perception of sequence, which do not admit of an unresisted change in their order, those which constitute our perception of co-existence admit of their order being inverted—occur as readily in one direction as the other.'—*Principles of Psychology*, p. 304.

tion, we bring other muscles into play, and get an impression of movement on a different portion of the moving system. In this way we should have the impression of a right angle, or a builder's square. The full impression of the pane of glass would arise through movements from side to side over its whole length, or from movements round the edge and several times across, such as to leave behind the feeling of a possibility of finding contact anywhere within certain limits of length and breadth. In this embodiment, and in no other that I know of, would an extended surface be conceived by the mind through muscularity and touch. (The action of vision will be afterwards discussed.)

A cubical block, exemplifying all the three dimensions of *solidity*, presents nothing radically new. A new direction is given to the hand, and a new class of muscles are brought to contribute to the feeling. The movement must now be over the length, over the breadth, and over the thickness, and the resulting impression will be a complication of the three movements. To get a hold of the entire solidity, it is necessary to embrace all the surfaces one after another, which makes the operation longer, and the notion more complex and more difficult to retain. But the resulting impression, fixed by being repeated, is of the same essential nature as the notion of a line or a superficies; it is the possibility, the potentiality, of finding surface in three different directions within given limits. A cubical block of one foot in the side means that, commencing at an angle, and going along one edge, a foot range may be gone over before the material ceases; that the same may then be done across, and also downwards; and that, between every two edges, there is an extended resisting surface.

The multiplying of points of contact, by our having a plurality of fingers, very much shortens the process of acquiring notions of surface and solidity. In fact, we can, by means of this plurality, come to measure a length without any movement; the degree of separation of the fingers, made sensible by the tension of their muscles, being enough.

Thus I can appreciate a distance of six or eight inches by stretching the thumb away from the fingers, as in the *span* of the hand. By keeping the fingers expanded in this way so as to embrace the breadth of an object, and then drawing the hand along the length, I can appreciate a surface by a single motion combined with this fixed span of the thumb and fingers. I may go even farther; by bringing the flexibility of the thumb into action, I can keep the fingers on one surface and move the thumb over another side, so as to have a single impression corresponding to solidity, or to three dimensions. We are, therefore, not confined to one form of acquiring the notion, or to one way of embodying it in the recollection; we have many forms, which we come to know are equivalent and convertible, so that where we find one, we can expect another. But the most perfect combination of perceiving organs is the embrace of the two hands. The concurrence of the impressions flowing from the two sides of the body, produces a remarkably strong impression of the solidity of a solid object. The two separate, and yet coinciding, images support one another, and fuse together in such a way as make the most vivid notion of solidity that we are able to acquire by means of touch. The parallel case of the two eyes is equally striking.

The notion of solidity thus acquired is complex, being obtained through a union of touch and muscularity, and combining perception of surface with perception of extended form. Space, or unoccupied extension, is movement *in vacuo*, from one fixed point to another; by the inverted operation, and by repetition giving the same contacts, this is considered to mean extension (as opposed to mere sequence in time). Empty space means the power of movement without contact or resistance, except at the extreme terms. Resistance and empty space are correlatives. In passing from the sense of the resisting to unresisted movement, we make the transition that developes the two cognitions of Body and of Space, under the common object property of Extension.

14. *Distance, direction,* and *situation,* when estimated by

touch, involve, in the very same manner, the active organs; the tactile sensations merely furnishing marks and starting-points, like the arrows between the chain-lengths in land-measuring. *Distance* implies two fixed points, which the touch can ascertain and identify; the actual measurement is by means of the sweep of the hand, arm, or body, from the one to the other. *Direction* implies a standard of reference; some given movement must fix a standard direction, and movement, to or from that, will ascertain any other. Our own body is the most natural starting point in counting direction; from it we measure right and left, back and fore. For the up and down direction we have a very impressive lead, this being the direction of gravity. When we support a weight we are drawn downward; when not sustaining the arms by voluntary effort, they sink downward; when our support gives way, the whole body moves downward. Hence we soon gain an impression of the downward movement, and learn to recognize and distinguish this from all others. If a blind man is groping at a pillar, he identifies the direction it gives to his hand, as the falling or the rising direction. Circumstances do not, perhaps, so strongly conspire to impress the standard directions of right and left, but there is an abundant facility in acquiring them too. The right deltoid muscle is the one chiefly concerned in drawing the right arm up and away from the body, and without our knowing anything about this muscle, we yet come to associate the feeling of its contraction with a movement away from the body to the right. All directions that call forth the play of the same muscles, are similar directions as respects the body; different muscles mean different directions. The great pectoral bringing the arm forward, the deltoid lifting it away from the side, the trapezius drawing it backward, indicate to our mind so many different positions of the guiding object; and we do not confound any one with the others. We learn to follow the lead of each of these indications; we make a forward step to succeed the contraction of the pectoral, a step to the right the deltoid, a step backward the trapezius.

Situation, or relative position, is known, if distance and direction are known. The idea of position implies three points. Two points might give extension, but relative position implies that we pass from A to B, from B to C, and from A to C. Such movements often repeated, both in the direct and in the inverse order, impart the idea of permanent co-existence in relative position, which amounts to an experience of Extension. The multiplication of these is the enlargement of our education in the co-existing and extended, from which at last, by an exercise of abstraction, we rise to the notion of Space or Extension in general.

Form or shape is determined by position. It depends upon the course given to the movements in following the outline of a material body. Thus we acquire a movement corresponding to a straight line, to a ring, an oval, &c. This is purely muscular. The fixed impressions engrained upon the organs, in correspondence with these forms, have a higher interest than mere discrimination. We are called upon to reproduce them in many operations—in writing, drawing, modelling, &c.; and the facility of doing so will depend, in great part, upon the hold that they have taken upon the muscular and nervous mechanism. The susceptibility and the retentiveness of impressions necessary to draw or to engrave skilfully, are principally muscular endowments.

15. So much for the qualities revealed to us by touch, either alone or in conjunction with movement. The accompaniment of activity belongs to every one of the senses; it serves to bring about, or increase, the contact with the objects of the sense. There is in connexion with each of the senses, a particular verb, or designation, implying action; to *taste* implies the movement for bringing the substance upon the tongue; to *smell,* or to *snuff,* means an active inhalation of the odorous stream; to *feel* signifies the movement of the hand or other organ over the surface in search of impressions; in like manner, to *hear* and to *see* are forms of activity. In the cases of taste and smell, the action does not contribute much to the sensation or the knowledge; in the

three others (two especially) it is a material element, since in all of them, direction and distance are essential parts of the information. Now, since movement is required to bring objects within reach, the value of any of our senses will depend very greatly upon the activity of the organs that carry the sensitive surface, the *tentacula*, so to speak. This activity grows out of the muscular and nervous energy of the frame, and not out of the particular endowment of the sensitive part. It is a voluntary exertion, at first spontaneous purely, always spontaneous in some degree, but linked to, and guided by, the sensibility. The flush of activity lodged in the arm and fingers is the first inspiration towards obtaining impressions of touch; the liking or disliking for the impressions themselves, come in to modify and control the central energy, and to reduce handling to a system.

16. Touch being concerned in innumerable handicraft operations, the improvement of it, as a sense, enters largely into our useful acquisitions. The graduated application of the force of the hand has to be ruled by touch; as in the potter with his clay, the turner at his lathe, the polisher of stone, wood, or metal, the drawing of the stitch in sewing, baking, taking up measured quantities of material in the hand. In playing on finger instruments—the piano, guitar, organ, &c.—the touch must measure the stroke or pressure that will yield a given effect on the ear.

17. The observations made on persons born blind have furnished a means of judging how far touch can substitute sight, both in mechanical and in intellectual operations. These observations have shown, that there is nothing essential to the highest intellectual processes of science and thought, that may not be attained in the absence of sight. The integrity of the moving apparatus of the frame renders it possible to acquire the fundamental notions of space, magnitude, figure, force, and movement, and through these to comprehend the great leading facts of creation as taught in mathematical, mechanical, or physical science.

18. The skin is liable to feelings not produced by an

external contact, but resembling what would arise from particular agencies, and suggesting those agencies to the mind. These are called 'subjective sensations.' The tingling of a limb asleep, formication—or a sensation as of the creeping of insects, heat, chilliness, &c., are examples.—(TODD and BOWMAN, I., 433.)

SENSE OF HEARING.

This sense is more special and local than the foregoing, but agrees with Touch in being a mechanical sense as distinguished from the chemical senses—Taste and Smell.

1. The *objects* of hearing are material bodies in a state of tremor, or vibration, brought on when they are struck, which vibration is communicated to the air of the atmosphere, and is thereby propagated till it reach the hollow of the ear.

All bodies whatever are liable to the state of sonorous vibration; but they differ very much in the degree and kind of it. The metals are the most powerful sources of sounds, as we see in bells; after these come woods, stones, earthy bodies. A hard and elastic texture is the property needed. Liquids and gases sound very little, unless impinged by solids. The howling and rustling of the wind arise from its playing upon the earth's surface, like the Æolian harp. The thunder is an example of a pure aerial sound; the effect, great as it is, being very small in comparison to the mass of air put in agitation.

It belongs to the science of Acoustics to explain the production and propagation of sound, and the forms of sounding instruments of all kinds. Here we are considering the effects, and not the instruments of sound. Even the human voice, whose description cannot be omitted in a treatise on mind, will come in under another head.

2. The *organ* is the Ear. 'It is divisible into three parts—the external ear, the tympanum or middle ear, and the labyrinth or internal ear; and of these, the two first are to be considered as accessories or appendages to the third, which is the sentient portion of the organ.'

The *external ear* includes 'the pinna—the part of the outer ear which projects from the side of the head—and the meatus or passage which leads thence to the tympanum, and is closed at its inner extremity by the membrane interposed between it and the middle ear (membrana tympani).'

'The *tympanum*, or drum, the middle chamber of the ear, is a narrow irregular cavity in the substance of the temporal bone, placed between the inner end of the external auditory canal and the labyrinth. It receives the atmospheric air from the pharynx through the Eustachian tube, and contains a chain of small bones, by means of which the vibrations, communicated at the bottom of the external meatus to the membrana tympani, are conveyed across the cavity to the internal ear, the sentient part of the organ. The tympanum contains likewise minute muscles and ligaments which belong to the bones referred to, as well as some nerves which end within this cavity, or only pass through it to other parts.'

As to the cavity of the tympanum, I shall content myself with quoting the description of the anterior and posterior boundaries, whereby it connects itself with the outer and inner portions of the ear, and which are therefore the main links in the line of communication from without inwards.

The outer boundary, formed by a thin semi-transparent membrane, the membrana tympani, which may be seen by looking into the ear, 'is nearly circular, and is slightly concave on the outer surface. It is inserted into a groove at the end of the passage of the outer ear, and so obliquely that the membrane inclines towards the anterior and lower part of the canal at an angle of 45°. The handle of one of the small bones of the tympanum, the malleus, descends between the middle and inner layers of the membrane to a little below its centre, and is firmly fixed to it; and as the direction of the handle of the bone is slightly inwards, the outer surface of the membrane is thereby rendered concave.'

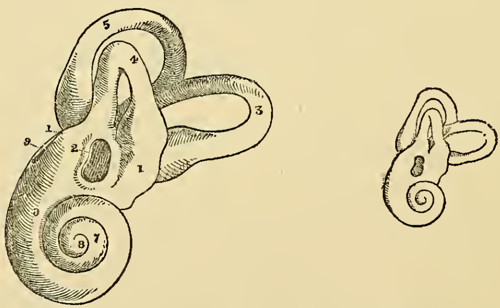
The *inner wall* of the tympanum, which is formed by the outer surface of the internal ear, is very uneven, presenting several elevations and foramina. The foramina or openings are two in number, the oval foramen (fenestra ovalis) and the round or triangular opening (fenestra rotunda). Both are closed with membranes, which render the inner ear, with its containing liquid, perfectly tight. To one of them, the oval foramen, a small bone, is attached, the other, the round foramen, has no attachment. These two openings are the approaches to the internal ear, and through them lies the course of the sonorous vibrations in their progress towards the auditory nerve.

The small bones of the tympanum are named from their appearance as follows (beginning at the outermost): the *malleus,* or hammer, attached to the membrane of the tympanum; the *incus,* or anvil; and the *stapes,* or stirrup, which is fixed to the oval opening in the inner ear, called the *fenestra ovalis.* The incus is thus intermediate between the other two, and the result of the whole is, 'a species of angular and jointed connecting rod between the outer and inner walls of the tympanic cavity, which serves to communicate vibrations from the membrana tympani to the fluid contained in the vestibule of the internal ear.'

There are certain small muscles attached to those bones for the regulation of their movements.

The *internal ear,* or *labyrinth,* 'which is the essential or sensory part of the organ of hearing, is contained in the petrous portion of the temporal bone. It is made up of two very different

Fig. 7.*



* 'An enlarged view of the labyrinth from the outer side:—1. Vestibule. 2. Fenestra ovalis. 3. Superior semicircular canal. 4. External semicircular canal. 5. Posterior semicircular canal. 6. First turn of the cochlea. 7. Second turn. 8. Apex of Cochlea. 9. Fenestra rotunda. * Ampullæ of semicircular canal.—The smaller figure represents the osseous labyrinth of the natural size.'—(Quain).

structures, known respectively as the osseous and membranous labyrinth'

'(1.) The *osseous labyrinth* is lodged in the cancellated structure of the temporal bone, and presents, when separated from this, the appearance shown in the enlarged figure. It is incompletely divided into three parts, named respectively the vestibule, the semicircular canals, and the cochlea. They are lined throughout by a thin serous membrane, which secretes a clear fluid.

'(2.) The *membranous labyrinth* is contained within the bony labyrinth, and, being smaller than it, a space intervenes between the two, which is occupied with the clear fluid just referred to. This structure supports the numerous minute ramifications of the auditory nerve, and encloses a liquid secretion.'

The minute anatomy of these parts I must pass over. The *vestibule* is the central chamber of the mass, and is the portion of the labyrinth turned towards the tympanum, and containing the cavities of communication above described. The *semicircular canals* are three bony tubes, situated above and behind the vestibule, into which they open by five apertures; each tube being bent so as to form the greater part of a circle. The *cochlea* is a blunt cone, having its surface 'marked by a spiral groove, which gives to this part of the labyrinth somewhat of the appearance of a spiral shell —whence its name.' Its interior is a spiral canal divided into two by a thin partition, deficient at the apex of the cochlea. The canal opens freely into the cavity of the vestibule.

'Within the osseous labyrinth, and separated from its lining membrane by a liquid secretion, is a membranous structure, which serves to support the ultimate ramifications of the auditory nerve. In the vestibule and semicircular canals, this membrane has the form of a rather complex sac, and encloses a fluid called the endolymph; in the cochlea, the analogous structure merely completes the lamina spiralis (the partition of the cochlea), and is covered by the membrane which lines the general cavity of the osseous labyrinth.'

The labyrinth is thus to be considered as a complicated chamber full of liquid, and containing also a membranous expansion for the distribution of the nerve of hearing. Let us next advert to the *action* of these different parts in producing the sensations of sound.

3. The waves of sound enter the passage of the outer ear, and strike the membrane of the tympanum. The structure of the outer ear is adapted to collect and concentrate the vibrations like an ear-trumpet. The form of the shell gives it a reflecting surface for directing the sound inwards ; while the passage is believed to increase their intensity by resonance. Reaching the membrane of the tympanum, the beats communicate themselves to its surface and set it vibrating, which is done all the more easily that the membrane is very thin and light in its structure. Experiments have shown, that the only means of receiving with effect the vibrations of the air, is to provide a thin stretched membrane of this nature. The vibrations of the membrane are communicated to the chain of small bones traversing the middle ear, and connected through the oval foramen with the enclosed liquid of the inner ear. By these means a series of beats are imparted to the liquid, which diffuse themselves in waves all through the passages of the labyrinth, and operate by compressing the membranous labyrinth, and through it the imbedded fibres of the auditory nerve, which compressions are the immediate antecedent of the sensation of hearing. The character of the sensation will of course vary with the character of the waves, according as they are violent or feeble, quick or slow, simple or complex, and so forth.

There is little difference of opinion as to the general course of the action now described. The transitions have all been imitated by experiments, and it has been found that the arrangement is a good one for bringing about the ultimate effect, namely, the gentle compression of the filaments of the nerve of hearing. No other medium could serve the final contact so well as a liquid, but in order to impress the liquid itself, an intermediate apparatus between it and the air is requisite. This intermediate apparatus is solid, and composed of two parts, the first a light expanded membrane, susceptible to the beats of the air, the second firm and compact (the chain of bones), to produce a sufficiently powerful undulation in the liquid. The membrane once affected is able to communicate vibrations to the bones; and the last of the chain, the stapes, is able to impress the labyrinthine fluid. So far the process has been rendered sufficiently intelligible.

The separate functions of the different parts of the inner ear are not understood. In the cochlea (the most important part), the membrane wherein the nerve is spread takes on peculiar tooth-shaped forms, and also contains elastic films or laminæ. The length of each lamina is about $\frac{1}{750}$ of an inch, and their thickness $\frac{1}{12500}$ of an inch. The laminæ lie upon the ends of the tooth-shaped forms, and are arranged like the keys of a piano, and closely packed together. Wundt believes that different tones affect different parts of the nerve of hearing thus disposed, and that as elastic bodies respond each to some particular tone, and remain quiet when other tones are sounded, so these elaastic laminæ are divided into groups for separate notes, and excite the connected nerve fibres accordingly.

There are three muscles in the interior of the tympanum attached to the small bones. The largest, called *tensor tympani*, is inserted in the malleus, and its direction is such as to draw inwards, and tighten the membrane of the tympanum. The second, *laxator tympani*, also inserted in the malleus, is supposed to have the action indicated by the name, but its muscular character has been doubted: the membrane of the tympanum would relax by mere elasticity, when the action of the tensor muscle is remitted. The third muscle is the *stapedius*, attached to the stapes, and seeming to govern the contact of that bone with the membrane of the oval foramen: the tensor tympani concurring with it to tighten the membrane.

It has not been well ascertained on what occasions and with what effect the tensor tympani is brought into play. The only distinct observation on the matter is that made by Wollaston, namely, that when the membrane of the tympanum is stretched, the ear is rendered less sensible to grave sounds, such as the deep notes of the organ, or the sounds of thunder and cannon. If, therefore, the ear is exposed to very intense sounds of the deep kind, such as the firing of artillery, the tensor tympani coming into play would in some measure deaden the effect. The action would make little or no difference to the hearing of acute sounds, such as the sharp notes of a call-whistle. Probably these muscles are excited by the reflex action of the sounds; possibly, also, they may be of the voluntary class, that is, they may come into play in the voluntary acts of listening and of preparing the ear to resist loud sounds. The only circumstance assignable as determining the reflex action of the tensor tympani is simply the intensity of the sound. We may suppose that every sound whatever brings on a reflex action to stretch the membrane, and the stronger the sound the greater the action. When sounds are too loud, and of the grave kind, this tension mitigates them; when too loud and acute, it either has no effect, or makes the evil worse.

'Dr. Wollaston performed many experiments upon the effects of tension of the membrana tympani, and he found that deafness to grave notes was always induced, which, as most ordinary sounds are of a low pitch, is tantamount to a general deafness. Shrill sounds, however, are best heard when the tympanic membrane is tense. Müller remarks, and we have frequently made the same observation, that the dull rumbling sound of carriages passing over a bridge, or of the firing of cannon, or of the beating of drums at a distance, ceases to be heard immediately on the membrana tympani becoming tense; while the treading of horses upon stone pavement, the more shrill creaking of carriages, and the rattling of paper, may be distinctly heard.'—TODD and BOWMAN, vol. II., p. 95.

4. Passing now to Sounds considered as *sensations*, we

may distinguish these into three classes; the first comprises the general effects of sound as determined by Quality, Intensity, and Volume or Quantity, to which all ears are sensitive. The second class includes Musical sounds, for which a susceptibility to Pitch is requisite. Lastly, there is the sensibility to the Articulateness, Distance, and Direction of sounds, which are the more intellectual properties.

5. *Sweetness.*—Under the head of Quality, the terms sweet, rich, mellow, are applied to the pleasing effects of simple sounds. Instruments and voices are distinguished by the sweetness of their individual tones; there is something in the material and mechanism of an instrument that gives a sweet and rich effect, apart altogether from the music of the airs performed upon it. Other instruments and sounds have a grating, harsh, unpleasant tone, like bitterness in taste, or a stink in the nostrils. Some substances, by their texture, have a greater sweetness of note than others. Thus silver is distinguished among the metals; and glass is also remarkable for rich, mellow tones.

The researches of Helmholtz and others seem to establish the fact that the differences of sounds as regards Sweetness (with its opposites), Timbre, and Vowel Quality, are owing to the combination of the principal tone of each with a number of *over-tones;* which combinations are susceptible of great variety. So strong is the tendency of sounding bodies to yield these over-tones—a vibrating string nearly always vibrates in fractions as well as in its whole length—that pure tones, although experimentally producible, are scarcely known to us at all. Tones very nearly pure arise from wide-stopped organ pipes. The effect of these on the ear is mellow, but insipid; they are intermediate between the sweet and the harsh.

According to this view, the sweetness, even of an individual sound, is a harmony; the ground tone is combined with over-tones in a pleasing concord. A harsh grating sound is a combination of dissonant tones. Noise, as opposed to the sweet or the melodious, is dissonance.

On this theoretical basis, the primary division of sounds would be into Simple sounds, Sweet combinations or concords, and Harsh combinations or discords. But as simple sounds are practically non-existent, we may still abide by the three-fold classification in the text, namely, (1.) Sweetness and Harshness, (2.) Intensity, and (3.) Volume. The second and third properties, Intensity and Volume, are important modifications of sound whatever be the degree of sweetness or of harshness; and they give a character to such as belong to neither extreme.

The sensation of the sweet in sound I have characterized as the simple, pure, and proper pleasure of hearing; a pleasure of great acuteness but of little massiveness. The acuteness of it is proportioned to the rank of the ear as a sensitive organ, or to the susceptibility of the mind to be stirred and moved through the channel of hearing. There is a great superiority in the endurableness of sweet sounds over the sweets of the inferior senses. In Touch the distinction exists in the comparison with Taste and Smell; in Hearing there is a farther progress, and we shall have to note the crowning pitch of this important property when we come to the sense of Sight. By virtue of this fact we can obtain from sight and hearing a larger amount of enjoyment within the same degree of fatigue or exhaustion, or before reaching the point of satiety. Hence one reason for terming these the 'higher senses.'

The persistence in the intellect, which governs the ideal continuance and reproduction of the pleasures and pains of sound, is of the same high order, and probably grows out of the same fundamental superiority of the sense.

The opposite of sweetness is described by the epithets harsh and grating, and is the characteristic pain of hearing. But in accounting for the extremely painful sounds, we must not confine ourselves to the fact of dissonance.

6. *Intensity, Loudness.*—Sounds are more or less faint or loud. A gentle or moderate sound, neither sweet nor harsh, is agreeable in stillness, simply as a sensation, and under the conditions wherein stimulation, as such, is pleasurable. According as the loudness of a sound increases, so does the

stimulation. The effect, at a given point, takes the character of pungency, like the action of ammonia on the nose, or a smart stroke on the skin. A loud speaker is exciting. The rattle of carriages, the jingle of an iron work, the noise of a cotton mill, the ringing of bells close to the ear, the discharge of musketry and ordnance, are all exciting from their intensity; to fresh and vigorous nerves plunged into them after quietness, these noises give pleasure. They may be described, however, as a *coarse* excitement; there is a great cost of tear and wear of nerve for the actual satisfaction.

The intensity, rising beyond a certain pitch, turns to pain. The screeching of a parrot-house, the shrill barking of the smaller species of dogs, the whistling in the fingers practised by boys in the streets, the screaming of infants, are instances of painful pungency. The sharping of a saw, and the scratching of a piece of glass, yield an intense shrill note. In most of these cases, we must suppose an element of dissonance as well as a great and smarting intensity. The only criterion of marked dissonance, as opposed to mere pungency, is the offence given to the ear under all conditions, and not merely under fatigue or exhaustion.

The *suddenness* of sounds, by the abrupt transition, aggravates their intensity on the general principle of Relativity. If unexpected, they produce the discomposure usually attending a breach of expectation.

7. *Volume* or *Quantity*.—This means the sound coming from a sounding mass of great surface or extent. The waves of the 'many sounding sea,' the thundery discharge, the howling winds, are voluminous sounds. A sound echoed from many sides is voluminous. The shout of a great multitude is impressive from the volume. Grave sounds, inasmuch as they require a larger instrument, are comparatively voluminous.

Whether sounds be sweet or indifferent, their multiplication has an agreeable effect on the ear. The sensation is extended in volume or amount without the waste of nervous power accompanying great pungency. Both physically and mentally, these sounds conform to the laws of massive sensation.

If a sound is intrinsically harsh or grating, or if painful from intensity, the increase in volume will be an increase of pain; as in machinery. The braying of the ass combines the harsh and the voluminous.

8. *Pitch* or *Tune*.—By pitch is meant the acuteness or graveness of a sound, as determined by the ear, and resolvable into the rate of vibration of the sounding body, or the number of vibrations in a given time. The gravest sound audible to the human ear is (according to Helmholtz) 16 vibrations a second; the highest audible sound corresponds to 38,000 vibrations a second; being a compass of eleven octaves. One of the deepest tones in use on orchestra instruments is the E of the double bass, giving $41\frac{1}{4}$ vibrations a second. The highest note of the orchestra (D of the piccolo flute) is 4752 vibrations. (Helmholtz : Tyndall's Lectures on Sound, p. 72). The practical range is thus about seven octaves. At the upper limit of hearing, persons differ as much as two octaves; the squeak of the bat and the sound of a cricket are unheard by some ears.

A sound of uniform pitch is a musical note. In the fact of uniform continuance, there is a pleasure of the nature of harmony. It is only such sounds that can be farther combined into musical harmonies.

Although, in music, less intervals than a semitone are not admitted, the ear can distinguish still smaller differences. A quarter of a tone makes a marked difference to an ordinary ear. A good musician can distinguish two tones whose vibrations are as 1149 to 1145, sounded after each other, and even a smaller difference if they are sounded together. Two pitchforks whose number of vibrations per second are 1209 and 1210, sounded simultaneously, can be distinguished by a first-rate ear.

9. The *waxing* and *waning* of sound. The gradual increase or diminution of the *loudness* of a sound, is one of the effects introduced into musical composition, owing to the

power it has to impart additional pleasure. The howling or moaning of the wind has sometimes this character, and produces a deep impression upon all minds sensitive to sound. The dying away of sound is especially noted as touching: 'that music hath a dying fall.' It may be, that a muscular feeling enters into this sensation: the gradually increased or relaxed tension of the muscles of the ear being a probable accompaniment of the increase or diminution of loudness. We cannot affirm, however, that it may not be due to the auditory nerves alone. When the *pitch* is gradually changed, as well as the degree, we have a farther modification introduced into musical composition, but apt to degenerate into the 'whine' or 'sing-song.' In the notes of birds, we may trace this effect; in the execution of accomplished singers, in the violin and other instruments, and in the cadences of a musical orator, we may likewise observe it; in all cases telling powerfully.

10. *Harmony* and *Discord*.—The concurrence of two or more sounds may be pleasing or unpleasing, irrespective of their character individually. The pleasurable concurrence is called Harmony. It is dependant upon the numerical relationship of the vibrations of the two sounds. Simple ratios, as 1 to 2 (octave), 2 to 3 (fifth), 3 to 4 (fourth), 4 to 5 (major third), 5 to 6 (minor third), are harmonious in the order stated. All these are admissible in musical composition, and are termed *chords*. The combination 8 to 9 (a single tone) is a dissonant combination; 15 to 16 (a semi-tone) is a grating discord.

It has already been mentioned that an individual sound whose character is sweetness, is already a harmony, or concord of many sounds; the main tone being combined with overtones. In music, these sounds are still farther combined, according to the general laws of harmony.

The pleasure of harmony is a wide-spread fact of the human mind; it extends to sight as well as to hearing, and is not wanting in the inferior senses; we may have harmonizing or discordant tastes. In the higher emotions, a concurrence may be either harmonious or discordant. The foundation of the pleasure is probably the same throughout; it is a general principle whereby mental states are regarded as either co-operating, or conflicting, with each other; in the one case, economizing nervous power and bringing pleasure; in the other, wasting power and causing pain.

11. *Timbre.*—This means the difference between sounds, otherwise the same, proceeding from different materials, instruments, or voices. We recognize a qualitative difference between the flute and the violin, or between the trumpet and the clarionet; we can distinguish between one violin and another, and between different voices sounding the same notes with the same intensity. These differences are now explained by the presence of auxiliary upper tones in all instruments; which tones vary with the material and the instrument. It is supposed that perfectly pure tones identical as regards pitch and intensity, would be undistinguishable, whatever might be their source.

12. *Articulate sounds.*—Of articulate sounds, some have a character so peculiar that our discrimination of them is no surprise. The hissing sound of *s*, the burring of the *r*, the hum of the *m*, are well marked modes of producing variety of effect. We can understand how each should impart a different kind of shock to the nerve of hearing. So we can see a reason for distinguishing the abrupt sounds *p*, *t*, *k* from the continuous or vocal sounds *b*, *d*, and *g*, and from the same sounds with the nasal accompaniment *m*, *n*, *ng*. It is not quite so easy to explain the distinction of shock between the labials, dentals, and gutturals; still, if we compare *p* (labial), with *k* (guttural), we can suppose that the stroke that gives the *k* is harder than the other.

The vowel sounds are explained by the over-tones (octaves) concurring with each fundamental tone, and varying according to the resonance of the mouth, the form of which is altered for each vowel. When the ground tone is heard nearly alone, the sound has the character of *u* (full). The *o* has, along with the ground tone, the next octave audibly combined. The *a* (ah) is characterized by the marked presence of the very high octaves.*

The same principle is applied to explain differences in the consonant sounds; but as respects these, there are other palpable distinctions such as we have alluded to above.

Some persons are distinguished by their nice discrimination of articulate sounds. If the foregoing theory be correct, a good ear for musical notes should be also a good ear for articulation, seeing that the articulate sounds involve composite musical tones. An ear for pitch is thus the basis both of music and of speech. Strictly speaking, however, this applies to the vowels. The discrimination of consonants may depend on other qualities of the ear; a circumstance requiring to be adverted to, seeing that, in point of fact, the good musical ear is not always a good articulate ear. The sense of Time is not confined to any organ or any class of feelings; but it may attain to great perfection in hearing.

13. The perception of *distance* can result from nothing but experience. I quote from Longet. 'As soon as the organ presents a sensibility and a development sufficient for discerning easily the relative intensity of two consecutive sounds, nothing farther is necessary in order to acquire the notions of distance and direction of the body from which the sonorous waves emanate. In fact, if a sound is already known to us, as in the case of the human voice, or an instrument, we judge of its distance by the feebleness of its impression upon the nerve of hearing; if the sound is one whose

* The following is Helmholtz's table for the leading vowel sounds:—

Vowel.	Ground-Tone.	2nd.	3rd.	4th.	5th.	6th.	7th.
u (full)	strong	—	weak	—	—	—	—
o (oh)	strong	strong	(weak)	(weak)	—	—	—
e (get)	strong	middling	strong	(weak)	(weak)	—	—
i (bit)	weaker	strong	(very weak)	strong	(middling)		
a (ah)	strong	(weak)	weak	middling	stronger	stronger	stronger

than 3 and 4.

The parentheses denote that the tones they inclose are not absolutely necessary to the making of the special vowel-sound.

intensity, at a given distance, is unknown, as, for example, thunder, we suppose it nearer according as it is louder.'

We are apt to mix inferential processes with our judgment of distance. If we are led to imagine that a sound is farther off than it really is, we seem to hear it stronger than it is. Awaking suddenly in the night, we hear a faint noise, and suppose it much louder, our notion of its real distance being for a few moments vague and confused. It being an effect of distance that sounds fade away into a feeble hum, when we encounter a sound whose natural quality is feeble, like the humming of the bee, we are ready to imagine it more distant than the reality.

14. *Direction.*—This is a purely intellectual sensation, in other words, is of importance as leading us to perceive the situation of the objects of the outer world whence the sound takes its rise.

The following extract from Longet indicates the kind of experience that gives us the feeling of direction :—

'With regard to the direction of the sonorous waves, we can at present only say, that the knowledge of it is owing to a process of reasoning applied to the sensation. Thus, we hear distinctly a sound emanating from a given point, whatever be the position of the head ; but the ear being able to judge of slight differences in the intensity of sounds, we remark that, in certain positions of the head, the sound seems stronger. We are hence led to place our head in one fixed position as regards the sounding body. But our sight tells what is this direction of most perfect hearing ; and we then apply the observation made on bodies that we can see to those that are not seen.'

The combined action of the *two ears* also favours the perception of direction of sound very materially. A person that has become deaf on one ear, is usually unable to say whether a sound is before or behind. The change of effect produced by a slight rotation of the head, is such as to indicate direction to the mind. For while the sound becomes more perceptible on one ear,—the ear turned to face the object more directly,—the sound in the other ear is to the same degree obscured. When the head is so placed, after various trials, that the greatest force of sensation is felt on the right ear, and the least on the left, we then infer that the sounding body is away to the right; when the two effects are equal, and when any movement of the head makes them unequal, we judge the sound to be either right in front or behind; and we can further discriminate so as to determine between these two suppositions.*

The sense of direction is by no means very delicate, even after being educated to the full. We can readily judge whether a voice be before or behind, right or left, up or down; but if we were to stand opposite to a row of persons, at a distance, say, of ten feet, we should not be able, I apprehend, to say which one emitted a sound. This confusion is well known to schoolmasters. So it is next to impossible to find out a skylark in the air from the sound of its song.

15. The duration of the feeling of an individual beat can be appreciated by noting at what intervals a succession of beats seems an uninterrupted stream of sound. This makes, in fact, the inferior limit of the audibility of sounds. From the experiments of Helmholtz, it would appear that a series of beats begins to be felt as continuous when they number

* According to Ed. Weber, in determining the direction of sounds, we employ the external ear for those coming from above, below, behind, before; the tympanum for those coming from left to right. He made the following experiments:—The head was inserted in water, the air-passage being filled with air, so that the tympanum was free to vibrate. In that case, the ear recognized the sounds as external to itself, but could distinguish them only as right or left in direction. When, farther, the ear itself was filled with water, and the free action of the tympanum arrested, the sense of externality altogether was lost. The feelings were regarded as subjective. It was observed by E. H. Weber that the uniting of the double sensation from the two ears (analogous to binocular vision) has its limits. If two watches with different rates of ticking are held before one ear, the ear distinguishes the periods when the strokes of the two fall together, and forms to itself a rhythm out of the two series of strokes. If the watches are applied, one to each ear, the sense of rhythm is lost. The mind can no longer make the combination effected when the two watches are applied separately to the two ears.

sixteen in a second; so that the impression of each must continue not less than the sixteenth part of a second.

16. The *subjective* sensations of the ear are such as buzzing, ticking, and humming sounds. They arise from disease of the brain, or the auditory nerve, obstructions in the tympanum and Eustachian tube, &c.

SENSE OF SIGHT.

1. The *objects* of sight include nearly all material bodies. Their visibility depends on their being acted on by Light, hitherto the most inscrutable of natural agents. Certain bodies, as the Sun, the Stars, flame, solids at a high temperature, give origin to rays of light, and are called self-luminous. Other bodies, as the Moon, the Planets, and the greater number of terrestrial surfaces, are visible only by reflecting the rays they receive from the self-luminous class.

The reflexion of light is of two sorts: mirror reflexion, which merely reveals the body that the light comes from; and reflexion of visibility, which pictures the reflecting surface. In this last mode of reflexion, the light is broken up and emitted in all directions exactly as from a self-luminous original. Visible surfaces receiving light from the sun have thus the power of absorbing and re-issuing it, while a mirror simply gives a new direction to the rays. When we look at a picture in a bad light, we find that the rays of reflexion overpower the rays arising from the coloured surface of the picture; consequently the picture is imperfectly seen.

As regards vision, bodies are either opaque or transparent. There is a scale of degrees from the most perfect opacity, as in a piece of clay, to the most perfect transparency, as in air. According as bodies become transparent, they cease to be visible.

The transparency of Air is not absolutely perfect; that is to say, light in passing through the atmosphere is to a certain small extent arrested, and a portion reflected, so as to make the mass faintly visible to the eye. When we look up into the sky through a cloudless atmosphere, all the illumination received beyond the sun's disc is light reflected by the atmosphere itself. Liquids are still less transparent; although they transmit light so as to show objects beyond them, they also reflect a sufficient portion to be themselves visible. Light falling upon the surface of water is dealt with in three different ways. One portion passes through, a second is reflected as from a mirror, a third very small portion is absorbed and radiated anew, so as to make the surface visible as a surface. The same threefold action obtains in transparent solids, as glass, crystal, &c. It is to be remarked of solid bodies that they are almost all transparent to a certain small depth, as shown by holding up their plates or laminæ to the light. Gold leaf, for example, permits the passage of light; and any other metal, if similarly attenuated, would show the same effect. There is, however, in this case, an important difference to be noted, inasmuch as objects are not distinctly seen, although light is transmitted; hence the name 'translucent' is applied to the case to distinguish it from proper transparency. There may be something more than a difference of degree between the two actions.

Opaque bodies may diffuse much light or little: some substances, such as chalk and sea foam, emit a large body of light; charcoal is remarkable for absorbing without re-emission of the sun's rays. This is the ordinary, perhaps not the full, explanation of white and black, the one implying a surface that emits a large portion of the rays of visibility, the other few or none.

Besides the difference of action making white and black, and the intermediate shades of grey, there is a difference in the texture of surfaces, giving birth to what we recognize as Colour. Upon what peculiarity of surface the difference between, for example, red and blue, depends, we cannot at present explain. But this fact of colour is one among the many distinctions presented by the various materials of the globe. Along with colour, a substance may have more or less of the property that decides between white and black, namely, copiousness of radiation. This makes richness of colour, as in the difference between new and faded colours, between turkey red and dull brick clay of a similar hue.

Some bodies are farther said to possess Lustre.

Mineral bodies present all varieties of light, colour, and lustre, but the prevailing tint of rocks and soils is some shade of grey. The reddish tint of clays and sandstones is chiefly due to the prevalence of oxide of iron. Vegetation yields the greenness of the leaf, and the variegated tints of the flower. Animal bodies present new and distinct varieties.

2. We come next to consider the *organ* of sight, the Eye.

'Besides the structures which compose the globe of the eye, and constitute it an optical instrument, there are certain external accessory parts, which protect that organ, and are intimately connected with the proper performance of its functions. These are known as the appendages of the eye (they have been named likewise 'tutamina oculi'); and they include the eyebrows, the eyelids, the organ for secreting the sebaceous (or oily) matter, and the tears, together with the canals by which the latter fluid is conveyed to the nose.'

'The eyebrows are arched ridges, surmounting on each side the upper border of the orbit, and forming a boundary between the forehead and the upper eyelid. They consist of thick integument, studded with stiff, obliquely set hairs, under which lies some fat, with part of the two muscles named respectively the orbicular muscle of the eyelids and the corrugator of the eyebrows.' By this last-named muscle the eyebrows are drawn together, and at the same time downwards, so as to give the frowning appearance of the eye; the opposite action of lifting and separating the eyebrows is performed by a muscle lying beneath the skin of the head termed the occipito-frontalis. In regulating the admission of light to the eye, and in the expression of the passions, these two muscles are called into play; the one is stimulated in various forms of pain and displeasure, the other in an opposite class of feelings.

'The *eyelids* are two thin moveable folds placed in front of each eye, and calculated to conceal it, or leave it exposed, as occasion may require. The upper lid is larger and more moveable than the lower, and has a muscle (levator palpebræ superioris) exclusively intended for its elevation. Descending below the middle of the eye, the upper lid covers the transparent part of the organ; and the eye is opened, or rather the lids are separated, by the elevation of the upper one under the influence of the muscle referred to. The eyelids are joined at the outer and inner angles of the eye; the interval between the angles varies in length in different persons, and, according to its extent, (the size of the globe being nearly the same,) gives the appearance of a larger or a smaller eye. At the outer angle, which is more acute than the inner, the lids are in close contact with the eye-ball; but at the inner angle, the caruncula lachrymalis (a small red conical body) intervenes. The free margins of the lids are straight, so that they leave between them, when approximated, merely a transverse chink. The greater part of the edge is flattened, but towards the inner angle it is rounded off for a short space: and where the two differently formed parts join, there exists on each lid a slight conical elevation, the apex of which is pierced by the aperture of the corresponding lachrymal duct.'—Quain.

The lachrymal apparatus is constituted by the following assemblage of parts—viz., the gland, by which the tears are secreted at the outer side of the orbit; the two canals, into which the fluid is received near the inner angles; and the sac with the duct continued from it, through which the tears pass to the interior of the nose. The description of these parts need not be quoted in detail here. Suffice it to say that the tears are secreted by the lachrymal gland, and poured out from the eyelids upon the eyeball; the washings afterwards running into the lachrymal sac, and thence by the nose.

The parts now dwelt upon are less concerned in vision, than in expression and other functions auxiliary to vision. Though not directly bearing on the object of the present section, they will be of importance when we come to consider the emotions and their outward display. From them we turn to the ball or globe of the eye.

'The globe, or ball of the eye, is placed in the fore part of the orbital cavity, fixed principally by its connexion with the optic nerve behind, and the muscles with the eyelids in front, but capable of changing its position within certain limits. The

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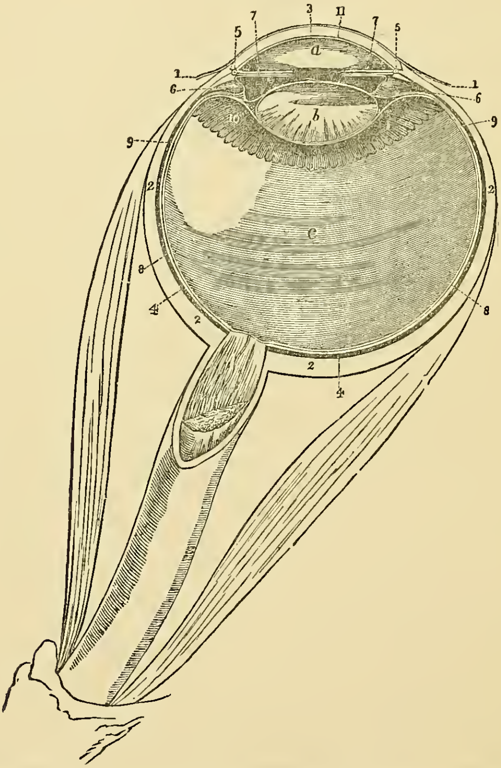
recti and obliqui muscles closely surround the greater part of the eyeball; the lids, with the caruncle and its semilunar membrane, are in contact with it in front; and behind, it is supported by a quantity of loose fat. The form of the eyeball is irregularly spheroidal; and, when viewed in profile, is found to be composed of segments of two spheres, of which the anterior is the smaller and more prominent; hence the diameter taken from before

Fig. 8.*



* Horizontal section of the right eye, with two of the muscles,—the external and internal recti,—and the optic nerve. *a.* Aqueous humour. *b.* Crystalline lens. *c.* Vitreous humour. 1. Conjunctiva. 2. Sclerotica. 3. Cornea. 4. Choroid. 5. Canal of Fontana. 6. Ciliary processes. 7. Iris. 8. Retina. 9. Hyaloid membrane. 10. Zone of Zinn, or ciliary processes of the hyaloid. 11. Membrane of aqueous humour.—(Wharton Jones *on the Eye.*)

backwards exceeds the transverse diameter by about a line. The segment of the larger sphere corresponds to the sclerotic coat, and the portion of the smaller sphere to the cornea.'

'Except when certain muscles are in action, the axes of the eyes are nearly parallel; the optic nerves, on the contrary, diverge considerably from one another, and consequently each nerve enters the corresponding eye a little to the inner or nasal side of the axis of the globe.

'The eyeball is composed of several investing membranes, concentrically arranged, and of certain fluid and solid parts contained within them. The membranes are three in number, an external fibrous covering named sclerotic and cornea, a middle vascular and pigmentary, in part also muscular, membrane, the choroid and the iris, and an internal nervous stratum, the retina. The enclosed light-refracting parts, also three in number, are the aqueous humour, the vitreous body, and the lens with its capsule.'

The *conjunctiva* is more an appendage of the eye than a portion of the globe. It is a thin, transparent membrane covering only the front or visible portion of the ball, and reflected on it from the interior of the eyelids, of which it is the lining mucous membrane. Over the clear and bulging portion of the eye it is perfectly transparent, and adheres closely to the surface; on the parts surrounding the clear portion it is less transparent, and contains a few straggling blood-vessels, which are seen as red streaks on the white of the eye.

'The *sclerotic*, one of the most complete of the tunics of the eye, and that on which the maintenance of the form of the organ chiefly depends, is a strong, opaque, unyielding, fibrous structure, composed of bundles of strong white fibres, which interlace with one another in all directions. The membrane covers about five-sixths of the eyeball, leaving a large opening in front, which is occupied by the transparent cornea, and a smaller aperture behind for the entrance of the optic nerve. The sclerotic is thickest at the back part of the eye, and thinnest about $\frac{1}{4}$ of an inch from the cornea. At the junction with the cornea it is thickened.

'The *cornea* is a transparent structure, occupying the aperture left in the fore part of the sclerotic, and forming about one-fifth of the surface of the globe of the eye.' The two together complete the encasement of the eye, and no other portion is employed for the mere purpose of maintaining the form and rigidity of the ball.

Spread over the inner surface of the sclerotic, lie two other membranous expansions, likewise termed coats or tunics, but of totally different nature and properties. Next the sclerotic, is the *choroid* coat, which is a membrane of a black or deep brown colour, lining the whole of the chamber up to the union of the sclerotic with the cornea, and then extending inwards as a ring stretching across the eye. It also is pierced behind by the optic nerve.

The choroid coat is an extremely vascular structure—that is to say, it is composed of a dense mass of blood vessels, which lie in two layers, the outermost of the two being the veins, and the other the arteries. Inside of those two vascular expansions, is the layer containing the black pigment that gives to the coat its colour, and which it is the object of the numerous blood vessels to keep supplied. The pigment is enclosed in the cells of a membrane, and these cells are packed very closely together, and are about the thousandth part of an inch in diameter. Each cell has a transparent point in its centre, surrounded by a dark margin.

The *retina*, or the nervous coat of the eye, is placed next the choroid, but does not reach so far forward. If a strong light is thrown upon it through the pupil of the eye, it appears of a reddish colour, which is owing to its blood vessels. When examined after death, it is pinkish and transparent. In the centre of the retina, and in the line of most perfect vision, is observed an elliptical yellow, or golden yellow, spot, about $\frac{1}{17}$ of an inch long and $\frac{1}{70}$ wide, in the middle of which is a dark depression called by the discoverer, Sœmmerring, the central hole. It is not a hole, but a thinner portion of the retina. About $\frac{1}{25}$ to $\frac{1}{20}$ of an inch from the inner or nasal side of the yellow spot, is a flattened circular papilla, corresponding with the place where the optic nerve pierces the choroid coat.

The retina consists of several layers. Beginning at the inside, which is in contact with the vitreous humour, we find a transparent membrane called the *limiting membrane*, whose thickness does not exceed $\frac{1}{50,000}$ of an inch. Next are the *ramifications of the optic nerve*, the fibres being arranged in fine meshes, and wanting the double outline. These fibres are exceedingly minute; the average diameter is not more than the $\frac{1}{30,000}$ or $\frac{1}{40,000}$ of an inch; while some are less than the $\frac{1}{100,000}$ of an inch in thickness. Within the fibrous layer, is a layer of *nerve cells or vesicles* resembling the vesicles that make up the grey substance of the brain. These are most abundant in the hinder or central parts of the retina: they vary from the $\frac{1}{6000}$ to the $\frac{1}{1500}$ of an inch in diameter. Then comes a still more complicated layer called the *granular and fibrous layer*, which constitutes the link of connexion between the retina and the choroid coat. It is made up of two distinguishable layers of little grains or nuclei, and a number of very fine filaments, with a direction perpendicular to the retina; at their outer connexion, these filaments are the $\frac{1}{60,000}$ to the $\frac{1}{40,000}$ in diameter; at their inner connexion with the fibres of the optic nerve, they are from the $\frac{1}{80,000}$ to the $\frac{1}{120,000}$ of an inch in diameter. The inner of the two layers, making up the granular and fibrous layer, immediately adjoins the choroid, and is called the columnar or *bacillar* layer, being made up of closely-packed perpendicular rods transparent and colourless, about $\frac{1}{1000}$ of an inch in length, and $\frac{1}{30,000}$ of an inch in thickness. Interspersed with these are larger rods called cones, $\frac{1}{2500}$ of an inch in diameter.* Each pigment cell of the choroid receives as many as six or eight of the cones, with a larger number of the smaller rods grouped round them. They are connected with the other parts of the retina by the fine perpendicular filaments.

It is interesting to notice how those several elements are disposed in the yellow spot and its vicinity, where vision is most perfect. From the margin of the spot towards the central hole, the rods of the columnar layer, the nuclei resting upon them, and the fibres of the optic nerve, gradually diminish, and at last fade away. On the central hole, nothing is left but the larger rods, or cones, with the fine perpendicular fibres, and the vesicles, which are here closer than anywhere else, there being one for every cone, and the layer being 7 or 8 cells thick. Those elements that thus disappear in the central hole, are, however,

* The above estimates of size are mostly taken from Kölliker, being transformed from millimetres by dividing by 24, (instead of 25 and a fraction), to keep to round numbers.

very abundant near the margin of the yellow spot. The smaller rods take the place of the cones, and the fibres of the optic nerve are very abundant and close. Thus, if we take the yellow spot together with its immediate surroundings, we find there the retina most highly developed ; and it is on this part that we can discriminate visible objects with the greatest delicacy. The unequal distribution of the different elements between the outer and inner parts of the yellow spot is remarkable.*

Before pointing out the different bodies that make up the bulk of the eye, and enable it to act as an optic lens, I must call attention to several other substances of a membranous or fibrous character lying under the cornea and near the junction with the sclerotic coat. The first of these is the *ciliary ligament*, a narrow circular band, of a greyish-white colour, close behind the junction above-named. The foremost margin, the thicker of the two, gives attachment to the circular curtain called the *iris*. The thinner and posterior margin is blended with the choroid coat, which here prolongs itself inwards in a series of radiated folds called the *ciliary processes*. The ciliary processes lie behind the iris, and make a black, wrinkled, narrow rim, concealed from external view.

* Mr. Herbert Spencer (Psychology, new edition, p. 35) indicates a class of structures, at the extremities of the nerves of sense, as *multipliers of disturbances*, or as serving to enhance the efficacy of the peripheral stimulation of the nerves. Thus in touch the short hairs render the skin more sensitive to contacts; while the so-called 'little bodies of touch' tend greatly to exaggerate the pressure upon the nerve fibres when the skin is compressed. In the ear, the otolites and minute rods and fibres, serve to transform the liquid vibrations into the more energetic vibrations of solids, so as to affect the nerve more powerfully. Finally, in the eye, the lenses concentrate the light upon the retina.

The structures at the back of the eye are interpreted on the same principle of increasing the susceptibility to slight disturbance; the luminous waves being the feeblest of all known agencies. The fibres of the retina are reduced to the naked core ; the protecting medullary sheath being absent. The light, passing through the transparent retina, affects the more susceptible pigment cells of the choroid coat, whence the disturbance is conveyed by the rods and perpendicular filaments to the nervous layer of the retina. Lastly, the nervous layer itself consists not only of fibres, but also of nerve vesicles or corpuscles, which are much more liable than the fibres to take on molecular disturbance, and originate molecular motions.

'The *iris* may rightly be regarded as a process of the choroid; it is continuous with it, although of a modified structure. It forms a vertical curtain, stretched in the aqueous humour before the lens, and perforated for the transmission of light. It is attached all round at the junction of the sclerotic and the cornea, so near indeed to the latter that its anterior surface becomes continuous with the posterior elastic lamina.' 'The anterior surface of the iris has a brilliant lustre, and is marked by lines accurately described by Dr. Jacob, taking a more or less direct course towards the pupil. These lines are important as being indicative of a fibrous structure.' When the pupil is contracted, these converging fibres are stretched; when it is dilated, they are thrown more or less into zigzags. The pupil is nearly circular, and is situated rather to the inner side of the centre of the iris. By the movements of the iris, it is dilated or contracted, so as to admit more or less light to the interior; and its diameter under these circumstances may vary from about $\frac{1}{20}$ to $\frac{1}{3}$ of an inch.'—TODD and BOWMAN, Vol. II., p. 25.

The iris is thus to be considered as a muscular structure, its fibres being of the unstriped variety, or of the kind that prevails among the involuntary muscles, as the muscular fibres of the intestines. It is abundantly supplied with nerves. While the radiating fibres above described serve to dilate the pupil, a second class of fibres, arranged in circles round the opening, and best seen at the inner margin and behind, operate in contracting it. The action is regulated by the intensity of the light. In the dark, or in a very faint light, the dilating fibres are tense and contracted to the full, making the pupil very wide. The stimulus of light brings the circular or contracting fibres into play, and contracts the opening. The changes thus affected are useful in adapting the eye to different lights, admitting a larger quantity with a feeble light, and a smaller quantity with one that is too strong. When this reflex power of adaptation reaches its limit, and the brilliancy is still too great, we then put forth the voluntary efforts of closing the eye, or of turning the head away from the object.

Behind the ciliary ligament, and covering the outside of the ciliary processes, is a greyish, semi-transparent structure, known as the *ciliary muscle.* 'It belongs to the unstriped variety of muscle, and its fibres appear to radiate backwards from the junction of the sclerotic and cornea, and to lose themselves on the outer surface of the ciliary body. The muscular nature of this structure is confirmed by its anatomy in birds, where it is largely developed, as noticed by Sir P. Crampton.'—TODD and BOWMAN, II., 27.

A peculiar interest has come to attach to this muscle, from its supposed operation in adapting the eye to objects at different distances.

Passing now from the coats of the eye to the substance, we find three *humours,* or transparent masses occupying it in the following order: in the front is the *aqueous humour;* next, the *crystalline lens;* and backmost the *vitreous* humour.

The *aqueous* or watery humour is a clear, watery liquid lying under the cornea in front, and bounded behind by the crystalline lens and the folds of the ciliary processes. This humour is very nearly pure water, containing in solution a small quantity of common salt and albumen; and is enclosed in a membrane, which is in contact with the inner surface of the cornea, in front, and the ciliary processes and lens behind. The liquid is partly before and partly behind the iris.

The *vitreous* or glassy humour lies behind the crystalline lens, and occupies the entire posterior chamber of the eye, being about two-thirds of the whole. It consists of a clear, thin fluid enclosed in a membrane, which membrane not merely surrounds it, but radiates inwards into its substance like the partitions of an orange, so as to make up a half-solid gelatinous body—the vitreous body, or posterior lens of the eye. These partitions are very numerous, and point to the axis of the eye, but do not reach to it; and consequently there is a central cylinder passing from front to back, composed only of the fluid of the body. The form of the vitreous body is convex behind, while before there is a deep cup-shaped depression for receiving the crystalline lens. The membrane that surrounds it on all sides, as well as entering into the interior, has a twofold connexion in front; it doubles so as to receive the crystalline lens between its folds, and it unites with the ciliary processes, which surround the lens without reaching its border. Thus the partition, between the aqueous humour in front, and the vitreous humour behind, is made up of three successive portions enclosing one another:—the wrinkled black ring of the ciliary processes outermost; within this, a ring of the doubled membrane of the vitreous humour; and inmost of all, the crystalline lens, enclosed between the two folds of the membrane.

The *crystalline lens* is a transparent solid lens, double convex in its form, but more rounded behind than before. It is suspended between the aqueous and vitreous humours in the manner already described. Its convexity before approaches very near the curtain of the iris stretched in front of it. The lens is enclosed in a capsule; and of this the front portion is thick, firm, and horny, while the portion on the back is thin and membraneous, adhering firmly to the membrane of the vitreous humour. The substance of the lens varies in its character; the outside is soft and gelatinous; beneath is a firmer layer; and in the centre is the hardest part, called the nucleus. It is supplied with blood vessels in the edges, but none appear to penetrate within except in a very early stage of life. It undergoes altogether a great change during the development of the individual. In the fœtus, it is nearly spherical, and not perfectly transparent; in mature life, it is of the form and character described above; while, in old age, it becomes flattened on both surfaces, loses its transparency, and increases in toughness and density.

Of the six *muscles* of the eye, four are called *recti* or straight, and two *oblique*. The four recti muscles arise from the bony socket in which the eye is placed, around the opening where the optic nerve enters from the brain; they are all inserted in the anterior external surface of the eyeball, their attachments being respectively on the upper, under, outer, and inner edges of the sclerotic. The superior oblique or trochlear muscle arises close by the origin of the superior straight muscle, and passes forward to a loop of cartilage; its tendon passes through the loop, and is reflected back, and inserted on the upper posterior surface of the eyeball. The inferior oblique muscle arises from the internal inferior angle of the fore part of the orbit, and is inserted into the internal inferior surface of the eyeball, behind the middle of the ball.

The motions of the eyeball that would be caused by the contractions of any of these muscles are not difficult to trace. The inferior muscle, by its contraction, will make the ball revolve so as to look downwards ; the superior straight muscle will make it look upwards. The internal and external recti will give it their respective directions, the one inward, the other outward. The action of the trochlear muscle is peculiar. Inasmuch as it is reflected backwards to be inserted in the globe of the eye, it will turn the eyeball downwards and outwards ; that is, the eye would, by its action, look obliquely downwards and outwards. This muscle tends also to draw the ball of the eye a little forward, or to make it protrude. The inferior oblique muscle, having its origin in the fore part of the orbit, and its insertion in the inner side of the eyeball, will, by its contraction, also draw the eye forward, and turn it upwards and inwards.

The external rectus is balanced by the internal rectus. The superior rectus is supported by the inferior oblique, in giving the eye its upward movement. The inferior rectus is supported by the superior oblique, in imparting the downward movement of the eye. There is thus a greater expenditure of muscular tension in moving the eye up and down than in the lateral movements. It may be this that gives a greater impressiveness to the vertical dimension ; the upright line of an equal cross appears to the eye longer.

All the movements of the eye could be performed by three recti muscles and one oblique ; the two others are, strictly speaking, supernumerary, but still operate. This makes it uncertain which muscles actually perform any one movement. The presumption is that we employ such muscles as in each case perform the movement with the least expenditure of force. Very few movements could arise from a single muscle. The movements possible by two muscles are not very numerous. Meissner gives twelve directions from the primary position of the eye, which is assumed as directed in a line

45° below the horizontal line. The eye, in passing from one part of the field to another, might be supposed to take the straight route. Wundt is of opinion that the straight route is preferred only in the horizontal and the vertical sweep. In other directions, the sweep is in a curve, which is greatest when the two points in the field of vision make an angle of 45° with the horizon.

3. Such being the mechanism of the eye, I must now touch briefly upon its *mode of acting* as the organ of sight. The optical part of the process is well enough understood. When the eye is directed to any object, an image of that object is depicted on the back of the eye, by means of the rays of light entering the pupil, and duly refracted by the different humours. The precise mode of stimulating the nervous filaments of the retina is not known; but the pigment cells of the choroid play an important part, being themselves highly absorbent of light; where they are not found, as at the place of entrance of the optic nerve, there is no power of vision (the blind spot). In order to perfect vision the following farther conditions are necessary:—

(1.) A sufficiency of light or illumination in the object viewed. This is an obvious necessity. We judge of the quantity of light present by the power we have of seeing objects distinctly. Some animals can see with much less light than others, and to such the noonday sun must be painful.

(2.) The formation of the image exactly on the retina, and not before or behind. The focus of the image must coincide with the retina. If this is not the case the image is indistinct; the rays of light either do not converge, or have begun to disperse, at the back of the eye. The perfect convergence of the image by the lenses constituting the ball of the eye, depends on the distance of the object, and also in some degree on the self-adjustment of the eye. 'As this power of adaptation of the eye itself for vision, at different distances, has its limits, there is in every individual a distance at which he sees most distinctly, and at which the focus of the image, formed by the refracting media of the eye, corresponds most accurately with the situation of the retina. This distance may be stated at from five to ten inches, in the majority of individuals. Objects which are too near the eye throw very indistinct images upon the retina; a slender body, such as a pin, held close to the eye, cannot be seen at all, or produces only an undefined impression on the retina. Few persons, on the other hand, are able to read print at a much greater distance than twenty inches.'

(3.) The third condition of perfect vision is the minute size of the subdivisions of the retina capable of independent sensation. We are sensitive to very minute lines and points; and there is a limit of minuteness, where a number of distinct lines would seem as one. This is the limit of the optical subdivision of the retina, analogous to the intervals of double sensation in touch.

It appears that minuteness of discrimination is aided by the following circumstances. 1. An intense light will enable a smaller object to be seen. 2. A white picture can be seen smaller than a blue. 3. A line can be seen better than a point of the same diameter. The smallest angle for a round body is 20″; a thread-like object is discernible under an angle of 3″; a glancing wire can impress the eye at an angle of $\frac{1}{5}''$. According to Weber and Volkmann, two bright lines must be separated at least from $\frac{1}{6000}$ to $\frac{1}{12000}$ of an inch on the yellow spot to give a double sensation; which is an estimate quite compatible with the observed minuteness of the fibres and vesicles of the retina, supposing each of these capable of conveying an independent impression to the brain.

The power of discrimination diminishes rapidly as the impression recedes from the yellow spot. At a point 60° from the centre of the spot, an object must be 150 times larger, in order to be distinguished. Thus, although the eye can take in a wide field at once, the power of minute observation is confined to a very small part in the centre of the retina.*

* Another condition of perfect vision has been suggested by the following experiments of Wundt:—If a small piece of red paper is held before the eye, and then moved to one side without the eye following it, so that the impres-

The great superiority of the eye, as a medium for perceiving the outer world, lies in this power of independent sensibility to minute points. I have already adverted to the distinction between the lower and the higher senses in this particular. The nerve of vision must needs consist of a number of independent fibres maintaining their distinctness all the way to the brain, and capable of causing distinct waves of diffusion throughout the entire cerebral mass; every one of these many thousand impressions varying the mental

sion is made first in the yellow spot, and then on the lateral parts of the retina, the colour is variously seen. To the yellow spot, the paper is red; as it moves sideways, it becomes darker; gradually, it assumes a blueish tint, and, at last, it appears perfectly black. Similar variations occur with any other colour, simple or mixed, and also with white, which unites all the colours. The last in the series is in all cases black. Whence it appears that different parts of the retina are differently sensitive to impressions of colour. The variation occurs in the same order in every direction, but with unequal rapidity. The series is passed through quicker, when the object is moved outwards, than when it is moved inwards; and also quicker for the upward than for the downward movement. It does not follow that in looking at a wide expanse of one colour, we see the gradations of tint in concentric rings. This is only one of many cases where the mind overbears the sense. We have contracted our notion of each surface from the way that its parts affect us when brought successively before the yellow spot—the place of minute examination—and what we seem to see is the habitual effect, rather than the effect at the instant. I shall afterwards allude to an important application of this fact, suggested to explain our power of localizing the different impressions made on the retina. I may advert here also to the phenomena of colour-blindness, and to the suppositions that have been made to account for it. We have already mentioned a speculation, to the effect that the different parts of the ear may respond to different tones or notes. A similar assumption has been extended to the eye. It is considered not unlikely that there are different nerve fibres and endings for the different primary colours, which endings are unequally mixed over the surface of the retina. It may be supposed that at one place violet rods predominate, at another green; and that in the yellow spot the red endings are most abundant. Colour-blindness would then consist in the deficiency or absence of one set of endings. The most frequent form of this defect is obtuseness to the primary sensation of redness; all coloured bodies are then seen as composed of green and violet. The spectrum to such persons is comprehended as of a yellowish and a blueish tinge. What they call white, the ordinary eye sees to be coloured. Colour-blindness has been known to exist with reference to green, but, as yet, not to violet.

experience, and originating a distinct volition. We shall probably meet with no fact attesting more conspicuously the complexity, and yet the separateness of action, of the cerebral system. We can easily satisfy ourselves of the reason why the cerebral hemispheres should be necessary to vision, considering what is thus implied in every instance of seeing whatsoever.

4. *On the Adaptation of the Eye to Vision at different Distances.*—If I see an object distinctly six inches distant from the eye, all objects at a greater distance are indistinct. The image of the near object falls correctly on the retina, the images of remote objects are formed in front of the retina. By a voluntary effort, I can adapt the eye to see a far-off object with tolerable clearness, but it then happens that any near body becomes confused. The questions arise—what is the change produced upon the eyeball, in the course of this adaptation from near to far, and from far to near, and what apparatus effects the change?

In seeing close at hand, the crystalline lens becomes thicker and more convex in front, in seeing at a distance, the surface is flattened. The change of curvature is considerable. The centre-point bulges out $\frac{1}{48}$th of an inch for near vision. A very slight increase takes place in the curvature of the hinder surface.

The changes of curvature depend on the action of the ciliary muscle. This muscle contracts for near vision; the effect of the contraction is to draw the choroid membrane forwards, and by that means to compress the vitreous humour, which exerts a pressure on the lens, pushing it forwards. At the same time, the muscular fibres of the iris come into play, contracting the pupil and also the outer circumference. This brings a pressure to bear upon the lens from before, but not an equal pressure; it is least at the centre and greatest towards the edges. Between these two pressures, from behind and before, the lens is bulged out in the middle, and its curvature increased. Thus, for near vision, there is a very considerable muscular action; when looking at anything close, we are conscious of a strain in the interior of the ball. For distant vision, this action is relaxed, and the natural elasticity of the parts restores the flattening of the lens. Hence the natural repose of the eye makes the adjustment for a distant prospect.*

The eyeball is subject to alteration chiefly for near distances. Between the smallest visible distance, say four inches, and three feet, nearly the whole range of the adjustment is gone through. When we compare distant objects of varying remoteness, as, for example, thirty feet with one hundred, or a thousand, very little change is effected on the form of the eyeball, the adjustment then depending on the greater or less convergence of the two eyes. This leads to the subject of double vision.

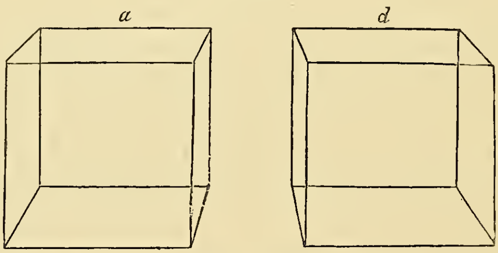
5. *Of single Vision with two eyes. Binocular Vision.*—Among the questions long discussed in connexion with sight, was included the enquiry, why with two eyes do we see objects single? Answers more or less satisfactory were attempted to be given; but since the year 1838, an entirely new turn has been given to the discussion. In that year, Professor Wheatstone gave to the Royal Society his paper on Binocular Vision, wherein he described his 'stereoscope,' or instrument for imitating and illustrating the action of the two eyes in producing single vision. The following quotation is from the opening paragraph :—

'When an object is viewed at so great a distance that the optic axes of both eyes are sensibly parallel when directed towards it, the perspective projections of each, seen by each eye separately, are similar, and the appearance to the two eyes is

* The limits of single vision are illustrated by the following experiment. If a thread is moved against a white wall, and we observe it with one eye through a tube, we can feel a difference when it is moved nearer, but not when it is moved farther away. This is consistent with the circumstances, that in changing to near vision, we cause a muscle to contract, while in changing to a more distant view, the natural elasticity of the parts releases an existing contraction. So, under the same circumstances, we may estimate the interval moved over by the thread, when it is brought nearer; but we can form no estimate of the absolute distance.—(Wundt.)

precisely the same as when the object is seen by one eye only. There is in such case no difference between the visual appearance of an object in relief, and its perspective projection on a plane surface; and hence pictorial representations of distant objects, when those circumstances which would prevent or disturb the illusion are carefully excluded, may be rendered such perfect resemblances of the objects they are intended to represent, as to be mistaken for them; the Diorama is an instance of this. But this similarity no longer exists when the object is placed so near the eyes that to view it the optic axes* must converge; and these perspectives are more dissimilar as the convergence of the optic axes becomes greater. This fact may be easily verified by placing any figure of three dimensions—an outline cube, for instance—at a moderate distance before the eyes, and while the head is kept perfectly steady, viewing it with each eye successively while the other is closed. The figure represents the two perspective

Fig. 9.



projections of a cube; *a* is seen by the right eye, and *d* is the view presented to the left eye, the figure being supposed to be placed about seven inches immediately before the spectator.'

'It will now be obvious why it is impossible for the artist to give a faithful representation of any near solid object, that is to produce a painting which shall not be distinguished in the mind from the object itself. When the painting and the object are seen with both eyes, in the case of the painting, two *similar* pictures are projected on the retinæ, in the case of the solid object, the pictures are *dissimilar;* there is therefore an essential

* The optic axis of the eye is the line of visible direction for distinct vision, or a line proceeding from the central point of the retina, and passing through the centres of the lenses of the eye.

difference between the impressions on the organs of sensation in the two cases, and consequently between the perceptions formed in the mind; the painting, therefore, cannot be confounded with the solid object.'

This dissimilarity of the pictures is the chief optical sign of solidity or of three dimensions. The greater the dissimilarity, the more decidedly is a third dimension suggested; perfect similarity occurs in looking at things very remote, or in examining a surface at right angles to the line of vision, all the parts being equally distant. Thus, when we gaze at a painting close at hand, we are not deluded into the belief of its being a reality. Anything near must have its parts at an equal distance from the eye, in order to present identical pictures, and we draw the inference accordingly. The stereoscope gives the illusion of solid effect by presenting to the two eyes dissimilar pictures, imitating the natural presentation in the case of an object or a scene unequally removed from the eye.

A great difficulty is experienced in explaining double vision, through mistaking the exact nature of the effect produced upon the mind by the impression made on the eye on one single occasion. We are apt to suppose that the entire conscious state at any one moment—the full imagery pictured to our view—is determined by the rays affecting the retina at that moment. The truth is, that what rises to the mind on the sight of an outward thing, is an aggregate of past impressions, which the impression of the moment suggests, but does not constitute. The education of the sense of sight makes us aware, that an identical impression upon both eyes concurs either with great distance, or with mere surface, that is, with two dimensions only, there being no inequality of distance from the eye. On the other hand, unlikeness of picture corresponds with the introduction of the element of unequal distance, and the more this inequality exists, the greater is the dissimilarity; and, accordingly, the mind, instead of being perplexed with double images, at once adopts the notion of a single complex object with varying remoteness, the variation being estimated among other signs by this very unlikeness of the pictures. It is immaterial whether the retinal presentations be two, as in binocular vision, or thousands, as in the vision of insects; these presentations are but the hint to a mental construction, representing the unity of the external scene, in its length, breadth, and depth.

6. Before quitting the consideration of the Eye, I should mention that *the seeing of objects erect by means of an inverted image on the retina,* has been conceived as a phenomenon demanding explanation. But to make this a question at all, is to misapprehend entirely the process of visual perception. An object seems to us to be up or down, according as we raise or lower the pupil of the eye in order to see it; the very notion of up and down is derived from our feelings of movement, and not at all from the optical image formed on the back of the eye. Wherever this image was formed, and however it lay, we should consider that to be the top of the object which we had to raise our eyes or our body to reach.*

7. And now as to the *sensations*, or the proper mental elements of Sight. These are partly optical, resulting from the effect of light on the retina; and partly muscular, arising through the action of the various muscles. Nearly all sensations of sight combine both elements.

8. I shall commence with the sensation of mere *light*, and shall take the diffused solar radiance as the leading example. This is one of the most powerful of the simple influences that affect the human sense. Light is eminently

* Still one can say (with Wundt) that, from the construction of the organ of vision, it even necessarily follows that the image should be inverted on the retina. The anterior and posterior convexities of the ball, it is clear, must always move in opposite senses. Take, then, what we call a downward movement of the eye, as when we run the eye down a spire from apex to base. This means, with reference to the retina, that we bring successively upon the yellow spot the different parts of the whole image, beginning with the image of the apex. But the retina being at the back of the eye, and the back surface mounting with the downward movement of the anterior, clearly what is apex in the real spire must be the lowest point of the retinal image—if the natural relation of front and back in motion is to be preserved.

a source of pleasure, which rises in degree, within certain limits, in proportion to the abundance of the luminous emanation. The degree is massive or acute, according as the effect proceeds from a diffused surface like the sky, or from luminous points as in artificial illumination. In either case it is possible to obtain a considerable amount of pleasure from this source. As a cheering influence, light ranks with warmth, alimentation, and pleasant repose. On the principle of Relativity, the full effect is experienced only after confinement in the dark.

The speciality of the pleasures of light is their endurableness. The influence, although powerful, is yet gentle ; it does not exhaust the nerves so rapidly as sweet tastes, pungent odours, or loud sounds. This is the great distinction of the sense of sight. Hearing also ranks high in the same property, but we must still assign to it the second place. One of the things understood by the term 'refinement,' as applied to pleasure, is this aptitude for being endured a great length of time without palling and satiety. The pleasures of sight are of a more lasting kind than those of the inferior senses. From this, and from some other circumstances that I do not here advert to, they enter into the feelings of the Beautiful. Light and shade, and the harmonious arrangement of colours, may suffice to constitute a work of Fine Art. The serene and soothing influence of sunshine furnishes a bond of connexion between effects of light and the tender feeling. The explanation I believe to be, that pleasure, when voluminous and not acute, generally subdues the active excitement and the energetic disposition of the system, and so brings the mind into the state most congenial to the pleasures of tender emotion.

As regards Volition, the pleasures of light so far accord with the general rule ; that is, they stimulate the will in proportion to their degree. We shun gloomy abodes and seek the cheerful day, or the well-lighted room ; when the sunlight is painfully excessive, we retire to the shade.

There is, however, a remarkable exception to this general rule. In the presence of a light too strong to be agreeable, the eye is worked upon, as by a spell or fascination, and continues gazing upon what gives pain or discomfort. The experimental proof of the fact is, that we find it a pleasing relief to interpose a screen between us and a light that we cannot divert the eye from, so long as it is within reach. Human beings experience, in a small degree, the fascination that in the moth is overpowering, even to self-destruction.

This is the first clear indication of the existence of tendencies thwarting the regular course of the will) which is *to* pleasure, and *from* pain); and constituting us, to that extent, irrational beings. Our sensations appear to have, in some cases at least, an efficacy to attract and detain us not only while wanting in pleasure, but also when positively painful. The present is an unequivocal instance.

With reference to Intellect, the sensations of sight have a marked superiority in the scale of the senses.

The pleasures and pains of sight possess, in the generality of minds, a higher ideal persistence and recoverability than the feelings of any other sense. If there be any exceptions to this rule, they are probably cases of unusual endowment and cultivation of the sense of hearing.

The endurability of the sensations without fatigue, and the comparatively easy persistence in memory or idea, may proceed from the same fundamental characteristic—the great delicacy of the shock of light on the nervous substance, as compared with the resulting sensibility.

In the most properly intellectual aspect—the bearings upon knowledge—the superiority of sight is still more pronounced. The sensations in the highest degree admit of being discriminated and identified; and also of being retained in memory as images of surrounding things.

The enjoyment of light demands alternation, and limitation as to amount. In sunny climates, the exposure to it for the entire day is excessive and exhausting; it has to be balanced by artificial darkness and shade. Places unable to afford the full quantity that human beings can enjoy, are styled gloomy and dull.

9. *Colour* introduces a new effect, as compared with white light. By a measured alternation of the different colours, we gain a new pleasure, which has all the distinguishing peculiarities of the pleasure of light and shade. The decomposition of the solar ray into certain primary colours, in fixed proportions, is an exact key to the harmony of colouring, or to the alternation most agreeable to the mind.

We commonly speak of the different colours as having characteristic effects; blue and green are reckoned mild or soft; red is fiery, pungent, or exciting. The eye when fatigued with the glare of sunshine, is said to find repose in the verdure of the fields. But these allegations cannot be maintained in an absolute sense. Colour, like all other things, operates in accordance with the principle of Relativity. The effect of any single colour is due to the transition from others felt previously. If red were the one universal tint, we should never have recognized colour at all, we should have spoken only of light and dark. The effects attributed to redness are due to its contrast with the prevailing tints about us. Next to white light and shades of dull grey, we are familiarized to blue and green. The balance is usually in favour of the blue end of the spectrum, and hence the occurrence of red is a lively stimulation. If the proportions were reversed in nature; if red and yellow took the place of blue and green, these last would be the exciting colours: they would have the freshness of rarity and novelty. The pleasure of newly-discovered shades of colour, as the mauve and magenta dyes, has no foundation but novelty and contrast. The variegated aspects of the fields and gardens in the bloom of vegetation, have more beauty than the unbalanced verdure of the leaf. The diffusion of red and yellow supplies the wanting ingredients of the picture. The colours of sunrise and sunset are the scenic splendours of the sky.

10. Artificial lights usually fail somewhat in the proportions of white light, and, therefore, have the pungency of an unbalanced colour. The flame of a fire is an agreeable stimu-

lation; the intensity does not amount to a painful excess. The light of a lamp arrests and detains the eye; the fresh sensibility of childhood is delighted with the effect, and soon learns the voluntary movements for following it when shifted about.

11. There remains to be noticed the sensation of *lustre.* The lustrous is opposed to the dull. The pleasure of lustre is greater than the pleasure of colour alone.

The most characteristic effect of lustrous bodies is the *sparkle,* or the occurrence of bright spots in the midst of comparative darkness—a marked case of light and shade. This is a combination highly favourable to the agreeable stimulus of light. Lustrous bodies have a mirror surface, and reflect the sun's rays in beams; these, starting out at points, are in strong contrast to the remaining surface.

The highest beauty of visible objects is obtained by lustre. The precious gems are recommended by it. The finer woods yield it by polish and varnish. The painter's colours are naturally dead, and he superadds the transparent film. This property redeems the privation of colour, as in the lustrous black. The green leaf is often adorned by it, through the addition of moisture. Possibly much of the refreshing influence of greenness in vegetation is due to lustrous greenness. Animal tissues present the effect in a high degree. Ivory, mother of pearl, bone, silk, and wool are of the class of brilliant or glittering substances. The human skin is a combination of richness of colouring with lustre. The hair is beautiful in a great measure from its brilliancy. The eye is perhaps the finest example; the deep black of the choroid, and the colours of the iris, are liquified by the transparency of the humours.

12. We have next to deal with the *complex sensations* of sight, those resulting from the combination of optical effect with the feelings of movement arising out of the muscles of the eyeball. As in the case of Touch, this combination is necessary as a basis of those perceptions of the external world that are associated with sight—Externality, Motion, Form,

Distance, Size, Solidity, and relative Position. Mere light and colour will not suffice to found these perceptions upon; as already maintained, in the exposition of Muscularity and of Touch, it is necessary to refer them to the *moving* apparatus of the eye and of the body generally.

13. *Visible Movements.* One of the earliest acquired of our voluntary actions is the power of following a moving object by the sight. Supposing our gaze arrested by a strong light, as a candle-flame, the shifting of the candle would draw the eyes after it, partly through their own movement, and partly by the rotation of the head. The consequence is a complex sensation of light and movement, just as the sensation of a weight depressing the hand is a sensation of touch and movement. If the flame moves to the right, the right muscles are engaged in following it; if to the left, the left muscles, and so on; and thus we have several distinct combinations of light and muscular impression, marking distinctness of direction, and never confounded with one another.

Motion, instead of continuing in one direction, may change its direction, and take a course crooked or curved. This brings into play new muscles and combinations, and leaves behind a different trace of muscular action. The right muscles of the eye may have to act along with the superior muscles, and at a shifting rate. This gives an oblique and slanting direction, which we can ever afterwards identify when the same muscles are similarly brought into operation. We have thus a perfect discrimination of *varying directions*, through the distinct muscles that they bring into play,

We can with the eye, as with other active organs, discriminate the greater or less *continuance* of a movement, and thereby estimate Duration in the first instance, and, in the next place, obtain another instrument applicable eventually to estimating Extended Magnitude.

Our muscular sensibility also discriminates rate or *velocity* of movement. A quick movement excites a different feeling from one that is slow; and we thence acquire graduated sensations, corresponding to degrees of speed, up to a certain limit of nicety. This estimate of the rate of contraction also indirectly serves as a means of judging of Extension, after we have arrived at the notion of visible Space, as opposed to Succession in Time.

The muscular sensibility of the dead strain, or of Resistance, can scarcely occur in the eye, there being nothing to resist its movements but its own inertia. What is called straining the eye (which happens in close and minute vision) is not the same thing as straining the arms in the support of a heavy weight. Hence of the three primary sensibilities of muscle—Resistance, Continuance, and Speed—two only belong to the ocular muscles. Accordingly the eye, with all its superiority in giving the mind the pictorial array of the extended world, cannot be said to include the fundamental consciousness of the object universe, the sense of Resistance. There is a certain kindred sensibility in the common fact of muscular tension; but it is by association, and not by intrinsic susceptibility, that the power of vision impresses us so strongly with the feeling of the Object world.

While the retina of the eye is receiving one and the same optical impression (in the supposed case of the candle-flame), this may, by movement, be imbedded in a great many different muscular impressions, and may constitute a great variety of pictorial effect. By changing the muscles and by varying their rate of action, we may so change the resulting impressions, that any one motion shall be recognized by us as distinct from every other, while each may be identified on a recurrence.

Many of the pleasures of Muscular Movement, described in the previous chapter, may be experienced in the *spectacle* of moving objects. The massive languid feeling of slow movement, the excitement of a rapid pace, the still higher pleasure of a waxing or waning speed, can all be realized through the muscles of the eye and the head. The slow procession, the gallop of a race-horse, the flight of a cannon-ball, exhibit different varieties of the excitement of motion. In the motion of a projectile, where a rapid horizontal sweep is accompanied with a gentle rise and fall, we have one set of muscles quickly moved, and another set in slow varying tension, thereby contributing the still more agreeable effect of increasing and dying motion. While the projectile flies across the field of view, the horizontal motion is uniform, but the pace upwards diminishes, and at last dies away at the highest point; the body then recommences a downward course, slow at first, but accelerating until it reach the ground. Hence the beauty of curves.

The pleasures of moving objects and stirring spectacle count for much in the excitement of human life. They are really pleasures of action; but inasmuch as only a very limited portion of muscle is excited by them, they do not constitute bodily exercise, and are therefore, to all practical intents, passive pleasures, like music or sunshine. Whence dramatic display, the ballet, the circus, the horse race, the spectatorship of games and sports, although engaging the activity of the eye, do not belong properly to our active enjoyments. They may, however, be the means of stimulating the general activity of the frame.

Among the *permanent imagery* of the *intellect*, recalled, combined, and dwelt upon in many ways, we are to include visible movements. The flight of a bird is a characteristic that distinguishes one species from another; and the impression left by it is part of our knowledge or recollection of each individual kind. The gallop of a horse is a series of moving pictures, which leave a trace behind them, and are revived as such. The motions that constitute the carriage and expression of an animal or a man, demand particular movements of the eye, in order to take them in and store them up among our permanent notions. All the gestures, modes of action, and changes of feature that emotion inspires, are visible to the eye as an assemblage of movements, and we recognize such movements as marking agreement or difference, among individuals, and in different passions. Many of the aspects of the external world impress themselves upon the moving apparatus of the eye. The surface of the sea, the drifting of clouds, the fall of rain, the waving of trees in the wind, the rushing of water, the darting of meteors, the rising and setting of the sun—are all mixed impressions of spectacle and movement. In like manner, in the various processes of the arts, there are characteristic movements to constitute our means of discrimination, and our permanent notions of those processes. The evolutions of an army have to be remembered as movements, and therefore need to be embodied among the muscular recollections of the system.

14. *Visible Form.*—We have taken the case of moving objects as the least complicated experience of vision. We must now enquire by what process we perceive Visible Form and Extension, and acquire the notion of Simultaneous existence in *Space*. It has to be shown that the eye is active in the observation even of still life; the special mode of activity being such as to make the mind feel the difference between Succession and Co-existence.

When we follow a moving object, as a rocket, or a bird, and when we carry the eye along the curve of the rainbow, there is a common fact of movement, with important differences in the mode. These differences are, to a great degree, parallel to those described under Touch, whereby the knowledge of objects as co-existing is attained. (1.) In the first place, in following the outline of the rainbow, we are not constrained to any one pace of movement, as with a bird or a projectile. This alone would give a lively sense of difference between the two appearances. (2.) In the next place, the optical impression, in the case of a still form, is not one unchanging sensation, but a series of sensations, which may be of the same nature—as in the rainbow, or may be all different—as in sweeping across the clouds or the landscape. (3.) Thirdly, we can, by an inverted movement, encounter the same series of optical sensations, in the inverted order; whereas, in the other case, the object passes finally away from the sight. (4.) In the fourth place, we may repeat the movement, at any rate of speed, and in so doing obtain the same series of sensations, in the same order. Both in touch and in sight, this circumstance is probably what, more than anything else, gives us that vivid sense of the difference between objects moving and passing away—thereby typifying Succession—and objects that are simultaneous or co-exist, which is the meaning of Space. The more frequently we experience this fixed recurrence of optical sensations, in company with a definite movement, the broader is the line between that mode of existence and the objects that give us only one chance of observing them. The constant reception of a definite series of sensations by one definite movement, and the equally constant occurrence of the series inverted under an inverted movement, go far to make up our notion, meaning, and expectation, of objects extended in Visible Space.

But, (5.) in the fifth place, as regards Sight, the peculiar power of the eye to embrace at one glance a wide prospect, although minutely perceiving only a small portion, is available to confirm the same distinction. When the glance is carried along the field of view, the portions that cease to occupy the centre of the eye, still impress the retina, and have a place in the consciousness, though much less distinctly perceived. This constitutes an additional distinction between the transitory flight of a meteor and the picture of the starry sphere. Touch possesses this means of discrimination only in a very limited degree. The extended surface of the hand, the plurality of fingers, the united touch of the two hands, and such extent of the surface of the body as can make a simultaneous contact,—are all that there is to correspond to this great prerogative of sight, in giving a plurality of simultaneous impressions, so as to mark the difference between the co-existing in Space and the successive in Time. When a definite series of successive sensations are *simultaneously* felt, they suggest *all the separate facts* of movement, together with the whole fact of movement, involved in a perception of the Extended.

Thus, then, the observation of the *forms* of still life is a combination of the movements of the eye, with the optical impressions corresponding to the different parts of the field of view. Exactly as in the case of moving things—by a horizontal sweep, we take in a horizontal line ; by a circular sweep, we derive the muscular impression of a circle ; by a sudden change of direction, we are cognizant of an angle ; there being, in all these instances, the persistence on the retina of the whole figure, while the eye scans the successive parts.

The transition is easy from Lines to Surfaces. A more numerous and complex series of movements is requisite to give the impression of a visible area or superficies. But the same constant series of optical effects, imbedded in the same movements, inverted and repeated as oft as we please, enters into the cognition of space in *two* dimensions, as well as into the perception of linear magnitude, or space viewed in one dimension.

15. *Apparent Size.*—The apparent size or visible magnitude is made up of the two discriminations—optical and muscular. The Optical discrimination takes place through the extent of the image on the retina ; hence the apparent size is spoken of by Wheatstone as the *retinal magnitude.* The Muscular discrimination depends upon the sweep of the eye under the action of its muscles ; and is, therefore, a fact or experience of our muscular energy or activity. The two estimates co-operate to a joint result. They are both equivalent to an angular estimate, or the proportion of the visible surface to a whole sphere. The apparent diameter of the sun or moon is half a degree, or $\frac{1}{720}$ of the circle of the sky.

The combined estimate of Retinal Magnitude, by our two most sensitive organs—the retina and the ocular group of muscles—renders our measurement of apparent size singularly delicate. In fact, this is the finest discrimination within the compass of our senses ; and whenever we desire to measure any property with nicety, we endeavour to resolve the case into a comparison of visible magnitudes. Of this description are the standards of weight (the balance), of heat (the thermometer), and many others.

The fluctuations of visible magnitude in consequence of changes of Distance are appreciated with similar delicacy; and after we are aware that these fluctuations correspond to alteration of *real* distance, we use them as the most delicate test of remoteness.

The celestial bodies and the clouds are conceived by us solely under their apparent or visible size. Terrestrial objects, being seen by us at different distances, vary in apparent size, and we conceive most of them under a more or less perfect estimate of their real size, as ascertained by handling and locomotion. Failing this estimate, we adopt some one point of view, which we have been most accustomed to, and conceive the object, as seen from thence. In regard to very familiar things, as a chair, or a man, we uniformly translate the apparent estimate into a real estimate. A building, a distant mountain, a landscape, are visually conceived as they appear from our most usual position with reference to them.

16. *Distance, or varying remoteness.*—The apparent size, as above considered, includes only two dimensions. In order to appreciate apparent volume or solidity, as an advance upon mere extension, or surface, we must estimate varying remoteness also.

Leaving out, at the present stage, the consideration of *real* distance, as well as real magnitude, we may advert to the various ocular sensibilities affected by alteration of distance.

We have already remarked on the two muscular adaptations of the eye to distance,—the change in the eye-ball by the operation of the ciliary muscle, for near distances, and the convergence or divergence of the two eyes, for distances both near and far. To preserve a distinct image when an object is brought nearer, we need, by a muscular effort, to change the curvature of the crystalline lens in each eye, and to make the lines of sight of the two eyes converge. Both these efforts are attended with consciousness, and this consciousness mingles with the feelings of altered retinal mag nitude, and with *dissimilarity* of binocular images, when objects retreat from the eye, or advance toward it; while, in addition, the optical fact of varying clearness may also tell, together with the presence or absence of intervening objects.

17. *Visible Movements and Visible Forms in three dimensions; Volume.*—By combining the visible movements across the field of view with the movements of adjustment—monocular and binocular—we attain the experience of visible movements, visible forms, and visible magnitudes, in all the three dimensions of space; in other words, *volume* and *solidity*, in so far as these are understood by the eye alone. An object moving aslant requires changes of adjustment along with the movements of the eyeball, right or left, up or down; and its image remains embodied in this more complicated series of movements and optical changes. A row of houses seen obliquely, needs the same combination. With the lateral movements of the eye, we must unite adjusting movements, in order to maintain the same distinctness of picture throughout. These changes of adjustment are repeated and inverted, along with the other movements, and conspire with these to give the sense of the co-existing in space, as opposed to the passing or successive in time.

18. The intellectual imagery derived through the eye from the forms of still life is co-extensive with the visible creation. For the purposes of discriminating and of identifying natural things, and also for the storing of the mind with knowledge and thought, the sensations of objects of sight are available beyond any other class. The eye is kept constantly at work upon the surrounding scene, following the outlines and windings of form, as these extend in every direction; and, by the movements thus stimulated, each sparate object is distinguished from those that differ in shape, size, or distance, and identified with itself and those that coincide with it in these peculiarities. The train of movements for a square are recognized as distinct from the train that describes an oval: the outline of a pillar brings on a cycle of motions wholly

different from those dictated by the figure of a tree. The property belonging to the mental system of causing to cohere movements that have been described in succession, fixes the series for each different view, and gives a permanent hold of all the distinct forms presented to the eye. This adhesive process belongs to the intellect, and will be fully treated of in the proper place.

CHAPTER III.

OF THE APPETITES.

1. IN taking up, at this stage, the consideration of the Appetites, I do not mean to assert that these entirely belong to our primitive impulses, or that in them the operation of intellect and experience is excluded. On the contrary, I am of opinion that Appetite, being a species or form of Volition, is like all our other effective forms of volition, a combination of instinct and education. But the process of acquisition is in this case simple and short; while, on the other hand, the stimulus to action, or the source of the craving, is usually one of the sensations or feelings discussed in the two previous chapters. Indeed, if we look at the craving alone, without reference to the action for appeasing it, that craving is merely what we have all along styled the volitional property of the sensation.

If a spur to action were to constitute Appetite, all our pains and pleasures would come under this designation. But the Appetites commonly considered are a select class of feelings; and are circumscribed by the following property—namely, that they are *the cravings produced by the recurring wants and necessities of our bodily, or organic life.* The avoiding of a scald, a cut, or a fall, is an energetic impulse of volition, and yet not a case of appetite; there being no periodic or recurring want of the system in these cases. *Sleep, Exercise, Repose, Thirst, Hunger, Sex,* are the appetites most universally present throughout the Animal tribes.

The state termed Desire so far agrees with Appetite, in being a volitional impulse growing out of some uneasy and unsatisfied condition. But in Desire, there is a prior experience of pleasure, the memory of which is the spur to seek a renewal; we desire to return to a tasted delight. This is not necessary to a mere Appetite; although obviously, after experience of gratification, all our appetites have also the character of Desires.

2. The fact of periodic recurrence is in no case more strikingly exemplified than in *Sleep*. After a certain period of waking activity, there supervenes a powerful sensation of repose. If we give way to it at once, the state of sleep creeps over us, and we pass through a few moments of agreeable repose into unconsciousness. If we are prevented from yielding to the sleepy orgasm, its character as an appetite is brought out into strong relief. The voluminous uneasiness that possesses all the muscles and organs of sense, stimulates a strong resistance to the power that keeps us awake; the uneasiness and the resistance increasing with the continued refusal of the permission to sleep, until the condition becomes intolerable, or until a reaction ensues, which drives off the drowsiness for some time longer. The overpowering influence of drowsiness is well seen in infants.

3. The necessity of alternating *Exercise* with *Repose*, through the entire range of our active organs, brings on the like periodic cravings and deep-seated uneasiness. The fresh condition of the muscles is of itself a sufficient stimulus to action; without any conscious end, in other words, without our willing it, action commences when the body is refreshed and invigorated. If this spontaneous outburst is checked, an intense uneasiness is felt, being one of the conscious states incident to the muscular system. This state is of the nature of all the other appetites, and increases with privation, unless, by some organic change, the fit passes over for the time. The dog chained up to his couch, the exuberancy of childhood restrained from bursting out, the bird in its cage, the prisoner in his cell—experience all the pains and desire of the active organs for exercise. On the other hand, after exercise, comes an equally powerful craving and impulse to rest, which, if resisted, produces the same intense uneasiness.

Under this head of Exercise and Repose I might include the more active of our senses, that is, Touch, Hearing, and Sight. These senses all embody muscular activity along with the sensation peculiar to each; and the muscular activity, together with the tactile, auditory, and visual sensations, lead to weariness of the parts, with a craving for rest; while, after due repose, they resume the fresh condition, and crave for the renewal of their excitement. The alternate exercise and rest of the senses is in a great measure involved in the rotation of sleeping and waking; indeed, the involuntary torpor of the nervous system, is almost the only means of giving repose to such constantly solicited senses as Sight, Touch, and Hearing.

A similar train of remarks might be extended to the activity of the thinking organs. But in these, the periodic cravings are less distinctly marked, and more frequently erroneous, than in the case of muscular exercise. There is often a reluctance to engage in thought, when the brain is perfectly vigorous and able to sustain it; and, on the other hand, there is, in nervous temperaments, a tendency to excess of mental action, uncorrected by any regular promptings to take repose.

The sense of fatigue, arising soon after beginning a laborious operation, and then disappearing, is connected with inaction of the brain. A little time is requisite to determine the flow of blood to the parts exerted.

4. *Thirst* and *Hunger* I have already touched upon. 'What is called *thirst* is sometimes rather a call for the cooling influence of cold drinks, as for instance, in the dry, hot state of the air-passages, mouth, and skin, produced in fevers by the increased temperature and diminished turgescence of the parts. Exhalation is in such cases often rather diminished, and the dryness of the surface arises from the circumstance that although blood still flows through the capillary vessels, the reciprocal action between the blood and the living tissues, which is denominated turgescence, or *turgor vitalis*, is depressed.'—(Müller, by Baly, p. 530.)

Hunger, unlike Thirst, is a state of the stomach, as yet not exactly understood; while the feeling of inanition, which also grows out of long fasting, must be considered as a general feeling of the system. The urgency of hunger ought to be in accordance with the actual deficiency of nutritive material, but very frequently the case is otherwise. 'It is heightened by cold baths, by friction of the skin, by friction of the abdomen, and by the agitation to which the abdomen is subjected in horse exercise, as well as by muscular exertion.' It is diminished by all nauseating influences, which probably at the same time weaken the digestion. 'The local sensations of hunger,' says Müller, 'which are limited to the digestive organs, and appear to have their seat in the nervus vagus, are feelings of pressure, of motion, contraction, qualmishness, with borborygmi (gripings), and finally pain.'

In the case of Hunger, as in most of the appetites, there is a double spur to the taking of food; first, the stimulus of uneasiness, and next the impulse arising out of the pleasure of eating. It is well understood that these two things are quite different, and on their difference hangs the whole art of refined cookery. Very plain food would satisfy the craving for nutrition, but there is a superadded pleasure that we have to cater for. The one is the appetite in its strictest signification, and as found in the lower animals; the other we may call a desire, because it supposes the remembrance and anticipation of a positive pleasure, like the desire for music, or for knowledge.

It is in the process of taking food and drink, that we best see exemplified the activity springing out of the sensations of hunger and thirst. The actual assuaging of the uneasiness produces an intense pleasurable sensation that sets on the most vigorous movements for being continued and increased; while the moving organs themselves, beginning to be invigorated, display a spontaneous and lively energy in the cause. To bring together, and make to unite, the sensation of the appeasing of hunger with the acts of sucking, prehension, masticating, and swallowing, is perhaps the earliest link of volition established in the animal system. This is the first case of action for an end, or under the prompting and guidance of a feeling, that the newly-born infant is capable of.

Besides the natural craving for the elements of nutrition required by the tissues, we may acquire artificial cravings by the habitual use of certain forms of food, and certain accompaniments, as peppers, flavours, &c. Thus we have the alcoholic craving, the craving for animal food, for tea, coffee, snuff, tobacco, &c.

5. The Appetite that brings the *Sexes* together is founded on peculiar secretions which periodically accumulate within the system, producing a feeling of oppression until they are either discharged or absorbed; there being a certain intense pleasure in discharging them for the ends of reproduction. If we were to place these feelings among Sensations, they would either form a class apart, or they would fall under the first class above described, namely, the Sensations of Organic Life. If the subject were open to full discussion, like the other feelings of human nature, it might be best to treat them as an organic sensibility giving birth to a special Emotion. We have in this case, as in Hunger, both Appetite and Desire; but we have also, what does not occur to a like degree in hunger, a many-sided susceptibility to inflammation,—through all the senses, through the trains of thought, and through various emotions.

6. The accustomed *Routine* of life leads to a craving almost of the nature of Appetite. As the time comes round for each stated occupation, there is a tendency or bent to proceed with that occupation, and an uneasiness at being restrained. So, our appetites properly so called may have their times of recurrence determined by our customary periods of gratifying them.

7. All the appetites are liable to be diseased or perverted, and to give false indications as to what the system needs. They are likewise liable to artificial and unseasonable inflammation, through the presence of the things that stimulate and gratify them. In the lower animals, it is assumed, I know

not with what truth, that appetite rarely errs ; in humanity, error is extremely common. We are apt to crave for warmth when coolness would be more wholesome ; we crave for food and drink, far beyond the limits of sufficiency ; we indulge in the excitement of action when we ought to cultivate rest, or luxuriate in repose to the point of debility. So doubtful is the appetite for sleep, that there is still a dispute as to how much the system requires. Perhaps the complicacy and the conflicting impulses of the human frame, are the cause of all this uncertainty and mistake, rendering it necessary for us to resort to experience and science, and to a higher volition than appetite, for the guidance of our daily life.

CHAPTER IV.

OF THE INSTINCTS.

1. IN the foregoing chapters have been enumerated all the primary modes of consciousness; we have now to consider in full the original provision in the human system, for ACTION. The name 'Instinct' is especially reserved for what is primitive or primordial on the active side.

More expressly, INSTINCT is defined as the *untaught* ability to perform actions of all kinds, and more especially such as are necessary or useful to the animal. In it a living being possesses, at the moment of birth, powers of acting of the same nature as those subsequently conferred by experience and education. When a newly dropped calf stands up, walks, and sucks the udder of the cow, we call the actions instinctive.

2. In all the three regions of mind,—Feeling, Volition, and Intellect,—there are certain primitive and fundamental arrangements, which education or acquisition proceeds upon. A full account of all our instinctive endowments may be included under the following heads.

I. The *Reflex Actions.*—These are actions withdrawn from the sphere of mind, and yet having analogies, as well as contrasts, with proper mental actions.

II. The primitive arrangements for *combined and harmonious actions.*—The rhythmical acts of walking, flying, swimming, &c., are examples of these. The Will may supply the stimulus to move, but the harmonious grouping of the movements is, in many instances, provided for among the natural endowments of the system.

III. The connexions existing at the outset between *Feeling* and its bodily manifestations.

IV. The instinctive germ of *Volition*. What we call the power of the will, has to be traced back, if possible, to some inborn or primitive stimulus, connecting together our feelings and our actions, and enabling the one to control the other. This is perhaps the most delicate inquiry that our science presents.

The primitive foundations of Intellect, I shall defer till the whole subject is entered on in the Second Part.

V. The description of the special mechanism of the *Voice*, will receive a place at the conclusion of this chapter, not having been included in the chapter on Movement.

THE REFLEX ACTIONS.

3. The Reflex, Automatic, or Involuntary actions, are marked by the absence of the circumstance characterizing voluntary actions, namely, the stimulus and guidance of *feeling*. Many of them are essential to animal life. They all demand a nervous arrangement, consisting of incarrying and outcarrying fibres, connected by grey matter. Some are maintained by the system of *sympathetic nerves and ganglia*, which are the most detached from the brain or centres of consciousness; others depend on the *spinal cord*; a third group are related to the *medulla oblongata*; and some are actuated by still higher centres, as the *pons varolii* and the *corpora quadrigemina*. Occasionally the sympathetic ganglia and a portion of the cerebro-spinal masses concur to the responsive movement.

The Reflex Actions may be distributed under the following heads.

First, those concerned in the organic processes, and operated through the involuntary muscles,—being the most widely removed of all from the mental or voluntary sphere.

The *rhythm* of the *heart* is usually counted among reflex actions, but no precise stimulant can be readily assigned. The power emanates mainly from the sympathetic system of nerves, and especially from the ganglia distributed on the heart itself; the rhythm continuing for some time, even after removal from the body. The influence is thus of the nature of regulated or rhythmical *spontaneity*, rather than of reflected action. The accomplished contraction of one portion of the muscular substance is the signal for commencing the contraction of another portion; and no other antecedent can be specified. The mere contact of the blood with the muscular wall of the organ is not to be considered a stimulant, such as would give rise to a reflex act. By galvanizing certain parts of the sympathetic system, in the neighbourhood of the heart, the beats are accelerated. On the other hand, by the stimulation of the vagi nerves, the action is weakened; this is in accordance with a tendency of the cerebro-spinal nerves to hold in check the influence of the sympathetic centres. It is found, however, that the complete removal of the cerebro-spinal centres has a weakening effect upon the heart's action, showing that, on the whole, some contribution to the force of its pulsations is derived from beyond the confines of the sympathetic system. So, irritation or excitement of the spinal cord of a recently decapitated animal, increases the force of the heart in common with the intestines and other viscera. While states of mental excitement, especially of the joyful kind, are accompanied with an improved tone of the circulation, depressing passions lower it; effects depending on the comparative energy of the sympathetic and the cerebro-spinal centres.

Connected with the circulation of the blood, there is also, what is called, the *vaso-motor* action; whereby the smaller arteries, which possess muscular fibres, are contracted or expanded, so as greatly to modify the local circulation. The contraction of these fibres, due to the influence of the sympathetic nerves, diminishes the bore of the vessels, and lessens the flow of blood to the parts; their relaxation widens the bore, and gives an increased flow, with rise of temperature and quickened action upon the nutrition of the locality. The permanent contraction, maintained in these fibres through the influence of the sympathetic centres, is one of the examples of the spontaneity of muscular energy, and is not a pure case of reflex stimulation.

Through the vaso-motor agency, the secretions and excretions are greatly affected by nervous influence; it being uncertain whether this is the sole instrumentality whereby the processes of organic life are subjected to the nervous centres.

More clearly reflex are the movements of the *intestines*. The whole of the intestinal canal is provided with muscular fibres, circular and longitudinal, of the unstriated or involuntary species. By the successive contraction of the circular fibres, aided by the longitudinal, the food is propelled along the entire course of the tube, through reflex stimulation. The first stage of the process commences with Deglutition, or swallowing, which succeeds to mastication. Of the three steps of deglutition, one is purely voluntary, being the propulsion of the food, by the concurrence of the lower jaw, mouth, and tongue, into the bag of the throat, called the pharynx; from which point the movements are purely reflex and involuntary. In the second stage, the contact of the food with the walls of the pharynx brings on the rapid contraction of the constrictor muscles of the pharynx, together with the auxiliary operation of the muscular fibres for raising the palate, and those (called *stylo-pharyngei)* for drawing the walls of the pharynx upwards. The third stage of deglutition occurs in the œsophagus, or gullet, whose circular fibres successively contract in a wave-like manner from above, downwards; while the longitudinal fibres, drawing up and widening the tube, facilitate the descent. This peculiar action, called the *vermicular* or *peristaltic* action of the intestines, is extended through the whole length of the canal. Both the cerebro-spinal and the sympathetic centres are concerned in maintaining the action. The stimulus is the contact of the food and of the various digestive fluids, of which fluids the most efficient is the bile.

This instance exemplifies reflex action in its simplest and most widely spread form, namely, contact with a surface responded to by the muscles of the locality. At each point, the food stimulates the circular and longitudinal fibres of the part touched and those immediately in the rear, so that the morsel is gradually propelled in the forward direction. In the pharynx, the action is violent and rapid (being under the powerful control of the medulla oblongata) ; as respiration is intermitted during the act, no time must be lost; while certain adjoining muscles concur with the muscles of the pharynx. In the intestine, the action is comparatively feeble and slow ; the time of descent of the food along the small intestine is estimated at about three hours.

Such is the regular course of reflex action in the alimentary canal. Among occasional and extraordinary stimulations, we may include the production of diarrhœa and colic by irritating substances; which is the same process in a more violent form. A strong irritation will operate at a distance from the part affected, as when these derangements of the bowels are brought on, in infants, from teething. This shows the influence propagated along the main chain of the sympathetic, instead of being reflected from a single point; it being the tendency of all powerful stimulation to extend its influence. The same tendency is shown in the other direction, when irritation of the alimentary canal spreads from the sympathetic ganglia to the cerebro-spinal centres, and produces, in infants, squinting and convulsions, and, in adults, epilepsy (through the medulla oblongata).

Among reflex acts, connected with digestion, we have to include *vomiting*. The most usual stimulus is the presence of indigestible, irritating, or poisonous substances in the stomach. The response necessary to vomiting is somewhat complicated. The act is proved to occur in two ways. One is by an anti-peristaltic movement of the intestine, or by an inversion of the order of contraction of the muscular fibres. It is conceivable that violence of irritation may have this effect, not by any specific nervous connexion, but by mere derangement of the usual rhythm. Colic and diarrhœa would be varieties of the same deranging stimulus. In the other mode, which is the one most frequently observed, the effect arises through the abdominal muscles. This will be adverted to under the next head.

In the Second class of Reflex Actions, organic processes are affected, but the instrumentality is the voluntary muscles. The chief example is *respiration*, depending chiefly on the medulla oblongata.

The great muscle of Respiration is the diaphragm, whose contraction performs the heaviest duty, namely, inspiration or drawing in breath; while the natural rebound or elasticity of the chest is the chief cause of expiration. Other muscles aid the diaphragm in the inspiratory act; and certain muscles, as those of the abdomen, the internal intercostals, the infracostals, and the muscles of the back, may co-operate with the elasticity of the chest, in expiration.

The action consists of a simple rhythm, or alternate contraction and relaxation of the diaphragm, as the muscle in chief; while the co-operating muscles, so far as brought into play, receive, in like manner, an alternated stimulation.

Although respiration is adduced as a perfect example of the reflex process, there is some doubt as to the exact stimulant employed. The commencing of respiration at birth is said to be due to the effect of cold—especially in the skin of the face—transmitted to the medulla oblongata by the nerves of the fifth pair. We must suppose, however, what everything confirms, that this nervous centre is itself a very energetic one, waiting only for the slightest touch to discharge itself with the requisite vigour. All through life, cold, especially on the face, stimulates respiration; even so small an application as the fan, in a heated room, rallies the weakened action of the lungs.

When respiration is once established, the stimulus is supposed to emanate from the surface of the lungs, and to be due to the influence of the venous blood, surcharged with carbonic acid and other impurities, and devoid of oxygen; but, in the absence either of decided facts, or of the analogy of a principle, this must be looked on as conjecture. Granting that there is reflex stimulation properly so called, we may assume that there is a considerable spontaneous emanation, modified but not created by stimulants.*

The principal circle of nervous action is by the vagus nerve (sensitive or incarrying), a small part of the back of the medulla oblongata, and the spinal accessory nerve (motor) originating near the vagus. The circle is extended by including the fifth pair (sensibility of the face); and by the spinal nerves (tactile

* When the sensory nerve distributed to the surface of the lungs is cut through, the breathing action is weakened, showing that a certain amount of stimulus is derived from the action going on throughout the surface. If, farther, the brain is paralyzed by any poison, the respiration is still more enfeebled, leading us to infer that the brain contributes to the breathing activity. Dr. Brown-Séquard has been led, by the examination of a great many cases, to the conclusion that the whole base of the brain is employed in respiration. He says:—'All the facts just mentioned, and many others, have led me, first, to abandon the view so generally admitted, that the medulla oblongata is the essential source of the respiratory movements in the nervous centres; and, secondly, to propose the view that these movements depend upon the *incito-motory* parts of the cerebro-spinal axis, and on the grey matter which connects those parts with the motor nerves going to respiratory muscles. The chief stimulus to respiration is the action on the surface of the lungs, but 'excitations from all parts of the body (as by cold, for instance), and also direct irritations of the base of the brain and of the spinal cord, almost constantly taking place, contribute to the production of respiratory movements.'—*Lectures*, p. 192.

and motor) all over the body. As above remarked, there is little complication in the process; the great desideratum is energy of impulse, following a very simple rhythm. In so far as the operation can be kept up by the diaphragm alone, it is the simplest of all arrangements; a mere exertion and remission of one definite stimulus. The accessory muscles are two opposed groups, like the flexors and extensors of the body; and that such muscles should be stimulated by turns is a consequence of their being stimulated at all. By the great law of conservation, to be noticed presently, a process so essentially linked with the vital energies of the system would extend the compass of the actions ministering to it, bringing into play remote accessories, as well as augmenting the power of the principal instrument, the diaphragm.

The breathing apparatus is the medium of certain acts, of occasional occurrence, more decidedly of the reflex character than the breathing function itself. One noted example is *coughing*. Although this act is accompanied with a painful sensation, giving birth to a voluntary impulse, which counts as part of the case, yet there is a marked concurrence of reflex, in the sense of involuntary, stimulation. The localities whose irritation makes us cough are—the glottis, the larynx with the air tubes of the lungs, and the throat or fauces. The irritants are diseased secretions from the lungs, and from the stomach, passing over those parts; also solid and liquid substances entering from without, as when food or drink enters the larynx; irritating gases; and, lastly, cold air. The first and immediate result of the reflex stimulus is, by the contraction of the arytenoid muscle, to close the glottis together with the upper opening of the larynx. The second act is a violent movement of expiration, such as to force open the glottis, and clear the passages of the irritating substances; the instrumentality being the abdominal and other muscles auxiliary to expiration.

The more purely reflex operation is probably seen in the first act, which follows the most general law of reflex stimulation—the contracting of the muscles of the locality affected. In the second act, the influence takes a wider sweep, and, through the medulla oblongata, finds its way, by the respiratory nerves, to the muscles of augmented expiration. The irritation produces that peculiarly unendurable feeling called tickling, which, though not of the ordinary character of acute pain, always prompts to energetic voluntary movements for getting rid of it. The explanation probably is, that we are made very uncomfortable by the reflex stimulation engendered through a slight touch of very sensitive parts. This second act, if not entirely voluntary, is so in part, and is prompted in the last resort by the self-conserving tendency, which is the only known source of volition.

Coughing may arise from cold air on the skin, from coldness of the feet, and from general chillness. In most of these instances, if not in all, there is an intermediate effect of the rise of phlegm from the lungs or the stomach, the consequence of the disturbing agency of the cold; so that the irritation of the glottis or neighbouring parts is still the direct influence.

Sneezing closely resembles coughing, and the two illustrate each other. The surface affected is the interior of the nose. The irritants are pungent gases, and foreign substances lodging in the cavities of the nostrils. The immediate response, parallel to the closing of the glottis in coughing, would appear to be the closing of the fauces, so as to divert the breath from the mouth to the nose. The more conspicuous act consists in a deep and sudden inspiration, followed by a clearing explosion through the nostrils by a grand expiratory effort. Some part of the stimulus must be regarded as voluntary, with a view to deliverance from the tickling sensation; for, although a sleeper may be made to sneeze by administering snuff or other pungent substance, the consciousness is awakened preparatory to the act. When too much light, or the rays of a fire, on the face or head, make one sneeze, there is probably first a reflex effect, of the vasi-motor kind, producing a flow of mucus in the nose.

Sucking is a reflex act, passing into the voluntary. The preparatory step is the closing of the lips round the nipple, a purely reflex process, stimulated by the mere contact. There are certain concurring adjustments. The tongue is brought forward to the nipple. In the throat, by means of the palate, uvula, and posterior pillars of the fauces, the entrance of air to the mouth through the nose and pharynx is prevented, while respiration is still possible (by the nose), except at the instant of swallowing. The act then consists in drawing away the tongue (the air-tight contact of the lips remaining), so as to produce a partial vacuum in the mouth, and a consequent in-flow of milk by atmospheric pressure. The mere withdrawing of the tongue, however, does not of itself suffice; this might be done, as any one can test, without swelling out the closed cavity of the mouth. Either there must be a bulging action of the cheeks, through the buccal muscles, or a momentary inspiration, with the nostrils closed, which would bring about the needful disturbance of the atmospheric equilibrium.

We have already alluded to the act of vomiting, as performed through the involuntary fibres of the alimentary canal. More usually and obviously, it takes place through the abdominal muscles. When the pyloric muscular ring (at the outlet of the stomach into the duodenum) contracts tightly, while the cardiac orifice (the entrance to the stomach) is open, the abdominal muscles, operating powerfully, expel the contents of the stomach from the mouth. The action is essentially an irregular one; the due concurrence of all the acts not being provided for by a preconceived arrangement. Sometimes the cardiac fibres are contracted, as well as the pyloric, through the reflex stimulation of the alimentary canal itself; in that case, the attempts at vomiting are ineffectual.

In order to procure the aid of the abdominal muscles, the medulla oblongata must be affected. Hence there is required a sufficiently powerful stimulation of the pneumo-gastric nerves. This may be gained by an irritating contact with the surface of the stomach, the most usual cause of vomiting. The effect may also arise by tickling the fauces, whence must proceed a very powerful stimulation to the medulla oblongata, at the point where the nerves issue to the abdominal muscles. Certain tastes are called nauseous, from their tendency to excite the stomach to vomiting; the nervous agency in this case being the glosso-pharyngeal nerves, also connected with the medulla oblongata. Nauseous odours probably operate through the same nerves; the olfactory track would carry the influence too far about. Certain sensations, in their origin still more remote from the stomach, bring on sickness; as a severe prostrating blow on the shin, the testicle, or on the eye-ball. The seat of irritation in this case is the brain, in the first instance, from which an influence is diffused to the medulla oblongata. The same may be said of violent emotion generally, which may lead to sickness. Concussion of the brain is also a cause. These circumstances would indicate the result as due to a great loss of cerebral power, and the disturbance of some tonic state or balance, permitting a special and local outflow of stimulus, which the healthy condition holds in restraint. The case of sea-sickness would readily accord with the same view.

The aid given to defæcation by the abdominal and expiratory muscles is probably altogether voluntary. Infants seem incapable of the effort; in them, accordingly, the reflex peristaltic movements of the intestines are the expelling instrumentality.

The expulsion of the male semen is a reflex act operated through the sensory nerves and the cerebro-spinal centres; the muscles are of the voluntary species.

In a Third class of Reflex Actions, the organic functions are affected through the medium of the cerebro-spinal system.

Salivation is controlled by the nerve of taste. A sapid body entering the mouth causes an increased flow of saliva. The salivary glands are all connected with the sympathetic system of nerves; the small arteries of the blood-vessels being kept at a certain point of contraction through the vaso-motor influence of the sympathetic. To produce an increased flow, the muscular fibres are relaxed by influence from the sensory nerves, apparently suspending or diminishing the action of the sympathetic ganglia. The *gastric* secretion in the stomach is influenced, probably in the same way, through the sensory nerve of the stomach, the pneumogastric. So, the flow of *milk* in the female breast is augmented by irritating the nipple.

The *flow of tears* is increased when a foreign body enters the eyelids. The same effect is caused by a strong light; also by irritating the conjunctival, nasal, and lingual branches of the fifth nerve, all which reflect influence on the sympathetic ganglia. When the flow is stimulated by the more remote disturbances of vomiting, violent coughing, laughing, and sobbing, there is probably an intermediate stimulation of the fibres of the fifth pair.

The flow of tears under pain is a relief from the congestion of the brain, and may be forced on by that circumstance, and not by the process last described. The effect of pain is to weaken the cerebral centres, and give more play to the sympathetic, so that the regular consequence is exemplified in the arrest of secretion (as, for example, the saliva and the gastric juice).

The *winking of the eye* is a reflex act, following the same stimuli as the flow of tears; namely, the presence of a foreign body, the accumulation of watery drops in the eye, and a strong light. The nerves of the fifth pair are the instrumentality; and the centres of influence are partly the sympathetic, partly the cerebro-spinal (in this instance, probably the medulla oblongata). The complete and energetic closure of the eye, involving not only the eyelids, but also the eyebrows, is altogether voluntary.

The movements of the *iris* are due to the sympathetic system, controlled by the sensory nerves of the eye-ball, and the motor nerves of the eye. The iris is contracted under a strong light, and expanded as the light becomes feeble. If the process be conducted on the analogy of the foregoing examples, the sympathetic ganglia would control the radial fibres, which keep the eye open; the abatement of this control by sensory action would allow the circular or contracting fibres to operate. It is possible, besides, that the fibres of the third cerebral nerve proceeding to the iris may be stimulated by a reflex influence of the light through some portion of the brain (as the corpora quadrigemina).

In the Fourth, and last, Class of Reflex Actions, muscles, more or less voluntary, are affected through the cerebro-spinal centres. Here we have an approximation to proper voluntary acts; the stimulant in all cases being accompanied with sensation, and the movement being such as the will could execute.

The first case that we shall mention is the contraction of the *ciliary muscle*, in the adjustment of the eye to near vision. This action, without our consciously willing or wishing it, succeeds to the feeling of indistinctness of the picture when anything is brought nearer to us. Consentaneous with the act, are the narrowing of the pupil and the convergence of the eyes; all the three adjustments co-operating to the distinct vision of near objects. The nerve for regulating the ciliary muscle is supposed to be a branch of the third pair; the contraction of the iris may be due to the same nerve, which likewise governs the convergence of the eyes, through the internal rectus muscle. The nervous centre more immediately concerned is the anterior pair of the corpora quadrigemina, stimulated through the optic nerve.

The *muscles of the tympanum* are controlled in a manner analogous to the adjusting muscles of the eye. The analogy extends to the mixed supply of nerves; those for the tensor tympani being derived from the sympathetic (like the radial fibres of the iris); those for the stapedius, from the fifth cranial nerve. On the theory of the action of these muscles that accords with the above analogy, the tensor tympani tightens both the membrane of the tympanum and the membranes of the foramina of the inner ear, under the influence of the sympathetic ganglia, and renders the ear susceptible, in the highest degree, to sound, like the radial fibres of the iris widening the pupil to the utmost. The feeling of sound in excess would then operate to relax those parts, by the stapedius muscle, which is stimulated through the facial (motor) nerve.

Under the same head we may place the *reflex movements* of the *Senses* generally. By these are understood the special movements of the organ itself, as distinct from the more diffused wave of influence accompanying lively sensation. Thus, an object placed in the hand specially stimulates the muscles that bend the fingers, besides producing the more distant effects associated with a sensation as a fact of consciousness. The effect may be seen in any one asleep. A bad smell affects specially the muscles of the nose; a bitter taste brings on wry movements of the mouth.

The word 'Reflex,' as applied to the actions now considered, needs to be specially guarded and explained. It is employed in cases where its obvious meaning is absent, and withheld in others where that meaning is present.*

The notion plainly attached to the word is a circle of influence, wherein there can be distinctly shown an outer or peripheral stimulation, conveyed by incarrying nerves to a ganglionic centre, and bringing on, by way of response, certain movements. The stimulation may be unconscious, as in the intestines, or conscious, as in the adjustment of the eye. The distinction is an important one; it marks out two grades of the effect, a lower and a higher; and distinct names have been employed to express the two—the phrase *excito-motor* being applied to the first, and *sensori-motor* to the second.

But it has been very properly remarked, that actions of the highest order of combined volition and intelligence may have

* The term 'automatic' is used as a synonym, or as a substitute, for 'reflex,' but with still less aptness for the purpose. It would serve to indicate the spontaneous activity, and that alone. With proper cautions and explanations, the name 'reflex' is the most suitable that has yet been proposed. 'Involuntary,' although applicable to the class (allowance being made for a margin of transition), is too wide in its meaning.

this reflected character. Any one promptly answering a question, exemplifies a reflex operation, so far as the general meaning is concerned. But such cases are not included among the so-called Reflex actions, these being set in marked contrast to voluntary actions of every kind.

Again, there are included in the class certain effects that are obviously wanting in the peculiarity implied in the name 'reflex.' Thus, we have seen that there are many movements due solely or mainly to central influence,—the so-called spontaneous movements; with regard to which, either no peripheral stimulus can be assigned, or the stimulus is insignificant compared with the energy of the response, an energy rising and falling with the physical condition of the central grey masses. The convulsive movements in certain ailments, as hydrophobia, hysteria, chorea, epilepsy, tetanus, &c., must be due to diseased changes in the condition of the nervous centres. These are involuntary movements, but they are not, strictly speaking, reflex. We may give a similar account of yawning; which is probably due to the unequal subsidence of the nervous action, disturbing the balance of the muscular tension. It would be a very forced supposition, to bring it under the literal meaning of reflex action.

In the enumeration of Reflex Actions, there is often included a group of effects distinct from any of the foregoing, namely, those typified by laughter, cries, sobbing, sighing, starting, fidgets, &c. These have been sometimes styled sensori-motor, because they are at the instance of sensations. This circumstance, however, does not show their real characteristic. They are, in my opinion, more aptly brought under *emotional* diffusion, expression, or embodiment. Every conscious state is accompanied with a diffused wave of effects, muscular and organic, which are stronger according as the feeling is more intense. Pleasing emotions are attended with one class of manifestations,—the smile, for example; states of pain with a different class. The leading emotions of the mind—Wonder, Fear, Love, Anger, &c.—have each a characteristic and well known embodiment or display.

These movements incorporated in our constitution as a portion of the very fact of being conscious (we are often said to be 'moved,' when it is only meant that an impression is made on the mind), may be called 'sensori-motor,' inasmuch as a sensation, when sufficiently powerful, always visibly stimulates them, rendering them, as it were, the return or response of the outward impression. They may also be styled 'reflex,' for the very same reason. They are, farther, 'involuntary' movements, being quite distinct from our volitional acts. But they are far from being unconscions: they are, if I am not mistaken, inseparable from consciousness, being entwined with the conscious condition in the mechanism of our frame. When consciousness is feebly excited, so are they,—so feebly that no visible manifestation results; when a stronger excitement is applied, they are roused in proportion. In a cultivated shape, they make the gesticulation and display that constitutes the usual expression or natural language of feeling, which no man and no people is devoid of, while some nations show it in a remarkable degree. The painter, sculptor, poet, actor, seize hold of these movements as the basis of artistic forms; and the interest of the human presence is greatly dependent on them, and on the attributes that result from them.

Confining ourselves to the strictly Reflex Actions, whether excito-motor, or sensori-motor, and omitting central spontaneity, emotional diffusion, and voluntary actions properly so called, we may now endeavour to generalize the facts, or to assign the most comprehensive laws at present attainable with regard to this process of the animal economy.

I. We trace one comprehensive arrangement, of wide prevalence throughout the animal kingdom, namely, the connexion between a peripheral stimulus and the movement of the part affected. This is the simplest and the most generalized type of the nervous system, demanding a circle made up of incarrying fibres, a central ganglion, and outcarrying fibres to the muscles of the same locality. In the lowest creatures possessing a nervous system, the structure and the function are as now described. The fixed mollusk responds to a contact by a movement contracting its body. In the experiments on decapitated animals, irritation of the foot is followed by retracting or else throwing out the limb.

Notwithstanding the higher complications super-imposed upon this simple arrangement, it is shown, almost pure, in many of the actions above described. The peristaltic movements of the intestines appear to be governed mainly by the contact with the part of the gut actually in movement. It is the same in the pharynx and œsophagus, and also in the rectum. In coughing, sneezing, and sucking, the first stage is a reflex stimulation to the muscles of the parts irritated. In the operation of the several senses, there is a reflex stimulus of the same character, although usually disguised and overpowered by the wider and more potent influences, respectively called emotional and volitional.

We may readily speculate upon the mode of action in these simple reflex circles. The peripheral stimulation is either simple contact, as in the touch of a solid body, or contact with absorption of material fitted to act on the nerves. In both cases a muscular disturbance of the nerves takes place, which is propagated to the ganglia, and there re-inforced by the more active changes occurring in the grey corpuscular matter; whence arises a molecular movement in the outgoing or motor nerves. It is not every stimulation, however, that imparts or evolves molecular activity; some stimulants, as cold, under certain circumstances, tend to lower, reduce, or destroy activity already existing. The most potent stimuli, as we might expect, are nutritive materials, and substances that, by combining with oxygen, or in other ways, generate force. The rise of temperature, in its direct or immediate consequences, contributes molecular power.

II. One step above the simplest reflex movement, is the alternation of two movements, carrying the same part to and fro. Wherever an organ is fitted with an opposing pair of muscles, both these have a connexion with the ganglion related to the part; both receive outcarrying fibres, and the local stimulus will excite movements in both; which movements, however, being opposed, must alternate with one another. It is an incident of such a situation that the muscles should fall into a reciprocating movement, and establish a nervous track inclining to this reciprocation; so much so, that the completed contraction of one, without any other stimulus, is an occasion of beginning a contraction of the other. The alternating contraction of opposing pairs, whether in joint response to a peripheral stimulation, or as a result of mere spontaneity, or, lastly, as a consequence of remote nervous instigation, is a fact of very wide generality, and is the least possible remove from the simple reflex circuit supposed in the foregoing paragraph.

III. The next advance in complexity is shown in the concurrence of several distinct movements in one act. Such a concurrence is required in deglutition, in sucking, in coughing, in forcible inspiration, in the adjustment of the eyes, and in locomotion. The regulating circumstance of the united action is the furtherance of some end in the economy. We know by what means combined movements are acquired, in ordinary education; namely, by tentatives under the guidance of the desired effect.

IV. The self-adjusting power now hinted at (to be afterwards fully elucidated in connexion with the Will) may be traced in the inferior region we have been considering. The supply of nutrition or other stimulus gives birth to molecular force, ending in muscular movement; which movement, in many circumstances, furthers the nutritive or other contact, and is thereby still further stimulated; as when the shell-fish in the sea opens its mouth to the water containing its food.

In several of the reflex actions above described, consciousness is usually present; as coughing, sneezing, sucking, the increased respiratory activity from cold, the reflex action of the senses, and the special adjustments of the ear and the eye. In so far as these actions arise during sleep, they may be regarded as independent of consciousness. But in some, consciousness is a part of the case; the object of them is, not to respond to a physical stimulation, but to remove an uneasiness; such are winking, and the adjustments of the eye to vision, and of the ear to sound. An obscure sense of discomfort is the antecedent circumstance in winking. To all these cases, we must apply the fundamental law of the will; they contain the essential fact of volition. They differ from the more usual forms of voluntary action, only in not engrossing our attention; we may be occupied with other matters while they are taking place. In this respect, they resemble actions in the stage of consummated habit.

Yet it is impossible to overlook the great resemblance to the course of voluntary action in those inferior reflex processes, commonly accounted devoid of consciousness. They are usually, although not always or necessarily, pointed to the conservation of the individual, which is the foundation circumstance of conscious and voluntary action. When several movements are united in one act, as in sucking, it is the better to answer some function of preservation.

We may not be able to draw a sharp line between the reflex involuntary and the voluntary: the two may shade into one another by insensible degrees; and a common fact or tendency of the system may be at the foundation of both.

THE PRIMITIVE COMBINED MOVEMENTS.

4. Of the primitive combined movements, in the human subject, the leading example is the *locomotive rhythm.* The instinctive character of locomotion, so obvious in the inferior animals, is less apparent in ourselves, seeing that the power of walking is not possessed by us until about a year after birth. Nevertheless, there are certain strong presumptions in favour of an original endowment entering into our aptitude for locomotion.

(1.) The analogy of the inferior quadrupeds countenances the probability of a locomotive rhythm in the human limbs. The community of structure of the vertebrate type is sufficiently close, to involve such a deep peculiarity of the nervous system as this. What nature has done for the calf, towards one of the essential accomplishments of an animal, is not unlikely to be done in some degree for man. To equip a creature for walking erect would doubtless be far more difficult, and might surpass the utmost limits of the primitive structural arrangements; but seeing that the very same alternation of limb enters into both kinds, and that nature gives this power of alternation in the one case, we may fairly suppose that the same power is given in the other also.

(2.) It is a matter of fact and observation, that the alternation of the lower limbs is instinctive in man. I appeal to the spontaneous movements of infancy as the proof. Mark a child jumping in the arms, or lying on its back kicking; observe the action of the two legs, and you will find that the child shoots them out by turns with great vigour and rapidity. Notice also when it first puts its feet to the ground; long before it can balance itself, you may see it alternating the limbs to a full walking sweep. Only in virtue of this instinctive alternation is walking so soon possible to be attained.

No other combination equally complex could be acquired at the end of the first year. Both a vigorous spontaneous impulse to move the lower limbs, and a rhythmical or alternating direction given to this impulse, are concerned in this very early acquisition. Let the attempt be made to teach a child to walk sideways at the same age, and we should entirely fail for want of a primitive tendency to commence upon.

(3.) It has been already seen, that the cerebellum is probably concerned in the maintenance of combined or co-ordinated movements. We have proof that these movements can be sustained without the cerebral hemispheres, but hardly without the cerebellum. Now, that the cerebellum should be well developed in man, and yet not be able to effect those harmonized arrangements found in the inferior vertebrata, is altogether improbable.

Unless some mode of invalidating these facts can be pointed out, the reasonable conclusion will be, that there is in the human subject a pre-established adaptation for locomotive movements, which adaptation we shall now attempt to analyze.

5. First, it involves the *reciprocation* or vibration of the limb. Confining ourselves to one leg, we can see that this swings back and fore like a pendulum, implying that there is a nervous arrangement, such that the completed movement forward sets on the commencing movement backward, and conversely. The two antagonist sets of muscles concerned in walking, are chiefly members of the two great general divisions of flexor and extensor muscles. Every moving member must have two opposing muscles or sets of muscles attached to it, and, between these, the limb is moved to and fro at pleasure. There is obviously an organized connexion between antagonist muscles generally, so as to give spontaneously a swinging or reciprocating movement to the parts; in other words, when any member is carried to its full swing in one direction, there is an impulse generated and diffused towards the opposing muscles, to bring it back, or carry it in the other direction. Of course this reaction will be most strongly brought out, on occasions when the commencing

movement takes a wide and energetic sweep. Thus in a swing of the arm carried up so as to point perpendicularly upward, we may discern an impulse in the opposing muscles to come into play in order to bring it down. Every swinging motion, whether of arm, leg, trunk, head, jaw, if not entirely due to volition, which it would be difficult to prove, must be supported by an arrangement of the nature now described.*

In walking, there is also, of course, a pendulous swing of the leg, arising out of mere mechanical causes. Like any other body hanging loose, the leg is really and truly a pen-

* On the antagonism of muscular movements generally, I quote the following statements from Müller :—

'There are groups of muscles opposed to each other in their action in almost all parts of the body. The extremities have flexors and extensors, supinators and pronators, abductors and adductors, and rotators inwards and rotators outwards. Frequently the opposed groups of muscles have different nerves. Thus the flexors of the hand and fingers derive their nervous fibrils from the median and ulnar nerves; the extensors theirs from the radial nerve; the flexors of the fore-arm are supplied by the musculo-cutaneous; the extensors by the radial nerve. The crural nerve supplies the nervous fibres for the extensors of the leg; the ischiadic those for the flexors. The perineal muscles, which raise the outer border of the foot, derive their nervous fibres from the perineal nerve; the tibialis posticus, which raises the inner border of the foot, is supplied by the tibial nerve. The circumstance of the convulsive motions in affections of the spinal cord being frequently such as to curve the body in a particular direction, shows that there must be something in the disposition of the nervous fibres in the central organs which facilitates the *simultaneous excitement* to action of particular sets of muscles, as the flexors, or extensors, &c.; although Bellingeri's opinion, that the anterior columns of the spinal cord serve for the motions of flexion, the posterior for those of extension, is based on no sufficient facts. Too much importance, however, must not be given to the above remark relative to distinct nerves supplying the different groups of muscles; it is not a constant fact. Sometimes the same nerve gives branches to muscles opposed in action; the ninth, or hypo-glossal nerve, supplies both the muscles which draw the hyoid bone forwards, and one muscle which retracts it; the perineal nerve supplies the perineal muscles, which raise the outer border of the foot, and the tibialis anticus, which opposes this motion. Antagonist muscles can, moreover, be most easily made to combine in action; thus the perineal muscles and the anterior tibial, acting together, raise the foot. The flexor carpi radialis and the extensor carpi radialis can combine so as to abduct the hand.'—p. 925.

dulum, and when thrown back begins to move forward of its own accord. Again, the extensor muscles, which maintain the body in an erect position, are antagonized by the weight of the parts ; hence in dancing up and down, the downward movement may take place by simply relaxing the tension of the supporting muscles. In the same manner, the jaw tends to drop of its own accord.

6. Secondly, there is implied in locomotion, an *alternate* movement of corresponding limbs, or an alternation of the two sides of the body. After one leg has made its forward sweep, an impulse has to be given to the other leg to commence a movement in the same course. The two sides of the body must be so related, that the full stretch of the muscles of the one side originates a stimulus to those of the other. Nothing less would suffice to enable a new-born calf to walk. The alternation between the right and left legs, both fore and hind, must be firmly established in the animal's organization by a proper arrangement of the nerves and nerve centres. And if the power of walking in human beings be assisted by primitive impulses and arrangements, this specific provision is necessarily implied.

The alternation of the two sides in locomotion extends beyond the muscles of the limbs ; the whole trunk and head sway in harmony with the members, both in quadrupeds and in man.

There are some important exceptions to this alternating arrangement ; but these are of a kind to place in a stronger light the examples of it now quoted. The two eyes are made to move together, and never alternate. This arrangement is the most prominent, but not the only, example of *associated simultaneous* movements. It has, doubtless, to do with the unity and singleness of the act of vision. Moreover, if we observe the early movements of the arms in children, we shall find in them more of the tendency to act together than to alternate ; showing, as we might otherwise infer, that the impulse of alternation of the limbs is not so deep-seated an instinct in man as in quadrupeds. In like manner, the movements of the features are, for the most part, the same on both sides of the face.

7. Thirdly. The locomotion of animals moving on all fours suggests a further necessity of primitive adjustment. It is requisite that there should be some provision for keeping the fore and hind legs in proper relation and rhythm. Something of the nature of the *vermicular* movement (that is, the locomotion of worms), or the movements of the alimentary canal, needs to be assumed in this case. Such a connexion must exist between the fore and hind segments, in order that the movements of the one may stimulate in succession the movements of the other, by a nervous *propagation* along the spinal cord to the cerebellum, or other centre governing the primitive rhythmical motions. In the crawling of reptiles, it is obvious that the muscular contraction in one segment or circle, must yield a stimulus to a nerve in connexion with the next circle, which is made to contract in consequence, and furnish a stimulus to the third, and so on through the whole line of the body: the action of the intestines being almost the same. In a dog, we see the movement of the limbs propagated to the tail. Each species of animal has its particular formula of ordering the legs in walking, determined, it may be, in part by the shape of the body, but duly transmitted in the breed as a property of its structure. The shamble of the elephant represents one species of rhythm; while the horse can pass through all the varieties of walk, gallop, and canter. In climbing, too, the alternation and the propagation both come into play as helps. In swimming, both are likewise apparent.

8. I must now mention more particularly the *associated* or consensual movements, or those that are so connected as to occur together. The most perfect example of this is in vision. In order to make the two eyes act together, the corresponding muscles of each must be simultaneously excited by the nerves. The following are the facts connected with this interesting case. I quote from Müller.

'Some of the most remarkable facts illustrating the association and antagonism of muscular actions, are presented by the muscles which move the eyes. The corresponding branches of the third, or motor oculi, nerve of the two sides have a remarkable innate tendency to consensual action, a tendency which cannot be ascribed to habit. The two eyes, whether moved upwards, downwards, or inwards, must always move together; it is quite impossible to direct one eye upwards and the other downwards at the same time. This tendency to consensual action is evidenced from the time of birth; it must therefore be owing to some peculiarity of structure at the origins of the two nerves. The association in action of the corresponding branches of the two nervi motores oculi, renders the absence of such tendency to consensual motion in the two external recti muscles and the sixth nerves more striking. We do, it is true, in a certain measure cause the two external recti muscles to act together when we restore the two eyes, of which the axes are converging, to the parallel direction; but there the power of consensual action ends; the two eyes can never be made to diverge, however great the effort exerted to do so. There is an innate tendency and irresistible impulse in the corresponding branches of the third nerve to associate action; while in the sixth nerves not only is this tendency absent, but the strong action of one of these nerves is incompatible with the action of the other. These innate tendencies, in the third and sixth nerves, are extremely important for the functions of vision: for if, in place of the sixth nerves, the external recti muscles had received each a branch of the third nerve, it would have been impossible to make one of these muscles act without the other; one eye, for example, could not have been directed inwards while the other was directed outwards, so as to preserve the parallelism, or convergence of their axes; but they would necessarily have diverged when one rectus externus had been made to act voluntarily. To render possible the motion of one eye inwards, while the other is directed outwards, the external straight muscles have received nerves which have no tendency to consensual action. In consequence, however, of the tendency in the two internal straight muscles to associate motion, it is necessary when one eye is directed inwards and the other outwards, that the contraction of the rectus externus of the latter should be so strong as to overcome the associate action of the rectus internus of the same eye;

and in the effort to direct one eye completely outwards, we actually feel this stronger contraction of the external rectus. These considerations enable us to understand perfectly the hitherto enigmatical fact that, in all vertebrata, the external rectus muscle receives a special nerve.'—(p. 929.)

The author then goes on to show the relation of the corresponding oblique muscles to each other, and the similar reason there is for having a distinct nerve to the superior oblique or trochlear muscle.

An association exists between the adjustment of the iris and the other movements of the eye; thus, whenever the eye is voluntarily directed inwards, the iris contracts. Hence the fact already stated, that the iris is contracted during near vision.

Müller also remarks that 'the motions very prone to be associated involuntarily, are those of the corresponding parts of the two sides of the body. The motions of the irides, of the muscles of the ear, of the eyelids, and of the extremities, in the attempt to effect opposed motions, are examples of such associations.' I have already remarked that this coincidence of movements on the two sides, co-exists, in the case of the limbs at least, with an organization for an alternating motion.

The same author further observes, that 'the less perfect the action of the nervous system, the more frequently do associated members occur. It is only by education, that we acquire the power of confining the influence of volition, in the production of movements, to a certain number of nervous fibres issuing from the brain. An awkward person, in performing one voluntary movement, makes many others, which are produced involuntarily by consensual nervous action.' (p. 928.) This, however, introduces much larger considerations, involving the whole mechanism of emotion and volition.

9. There are various appearances that suggest the existence of a law of general *harmony* of state throughout the muscular system. In stretching the lower limbs, we feel at

the same time an impulse to stretch the arms, the trunk, the head, and the features, or to put in action the whole class of extensor or erector muscles. The act of yawning propagates a movement over the whole body. I cannot positively affirm that this may not be explained by similarity of state producing everywhere a similar impulse, but the appearances are more in favour of a harmony of condition produced through the nervous system. When the eye is gazing attentively on an object, the whole body is spontaneously arrested, the features are fixed, the mouth is open; and the same harmonizing fixity is observed in the act of listening. So, a movement in one part propagates itself to other parts, unless a special check is maintained; the movements of the eye excite the whole body. Vocal utterance brings on gesticulation. The *pace* of movement is also rendered harmonious. Rapid movements of the eye from exciting spectacles make all the other movements rapid. Slow speech is accompanied by languid gestures. In rapid walking (before the exercise has a derivative effect on the brain), the thoughts are quickened.

These movements are to be ranked among the primitive impulses that serve the useful ends of the animal; they count among the *practical* instincts now under discussion. They cause the animal to come into harmony with the circumstances that surround it,—to be quiet when the scene is still, to start up and join when others are stirring.

This property imparts character to individuals. A person is either slow or vivacious, generally; the cast of movement is the same in all organs, in action and in thought. From it arises, likewise, a means of rousing and controlling the actions, thoughts, and passions, of men and animals.

In the cries of human beings and animals, which is a part of the expression of feeling, there is a primitive combination or concurrence of movements, remarkable for its uniformity. The tension of the vocal cords, through the laryngeal muscles, the forced expiration, and the adjustment of the mouth, are united in the same act. Possibly these are concurring effects of the emotional wave, or the diffused stimulus of strong feeling, to be noticed presently.

10. There are certain cases, where one sense can apparently act for another, previous to experience, as when an animal detects wholesome or unwholesome food by the smell, before tasting it. That the sense of taste should inform us of what is good for digestion (which it does to an imperfect degree in the human subject), is not surprising, seeing that, in the mouth, the alimentary canal is already commenced; we feel more difficulty in discovering how *smell* should have this power of anticipating digestion and nutrition.

The effluvia that bodies emit to the nostrils, may be a specimen or representative of their substance as applied to the stomach, and may have something of a like effect on the nervous system. We know that the smell of putridity causes loathing and disgust, and that an attempt to eat such material would only complete the effect already begun; while, on the other hand, substances that have a sweet or fresh flavour, would in all probability be free from nausea in the stomach.

On the general fact of one sense acting for another by way of warning or invitation, it is to be remarked that a deep harmony appears to exist among the different senses, in consequence of which we apply common epithets to the objects of all of them. Thus, the effect we call 'freshness,' determined by the stimulus of the lungs, the digestion, or the general nervous tone, arises in several of the senses. The difficulty is to find the *same external object,* acting in the same manner upon two or more of them, as in the case of discerning food by the sight, or by the smell. I am of opinion that these coincidences, recognized before experience, are very few in number, and that the great safeguard of animals lies in making the direct experiment of eating what comes in their way, and in deciding according to the feelings that result therefrom.*

* It is a fact that lambs commence eating, not the short tender grass, but the long and dried tops.

Among concurrences in Sensation, there may also be noticed the facts known as the transference, radiation, and reflexion of sensations. Reference has already been made (REFLEX ACTIONS, p. 250) to the tendency of violent nervous stimulation to extend its sphere into collateral tracks. There are certain cases of definite and uniform transference of the seat of a sensation to a distant locality. In disease of the hip, the pain is felt in the knee; when the kidney is the seat of irritation the feeling of pain may be localized in the heel; certain diseases of the brain are accompanied with pains in the limbs (Marshall's Physiology, Vol. I., p. 347).

THE INSTINCTIVE PLAY OF FEELING.

11. In following out our present object, which is to pass in review all that is primitive among the sensibilities and the activities of the mental system, we shall next consider the instinctive or original mechanism for the expression of Feeling.* It is well known that some of the most conspicuous among the manifestations of human feeling, as Laughter and Tears, belong to us from our birth. Education here finds work in repressing original impulses, no less than in imparting new and artificial forms of emotional display.

It will be instructive to quote the section devoted to this subject in Müller's *Physiology*. The professed title of the section is, *Movements due to the Passions of the Mind.*

* I have already referred (see p. 258), to the general law which I believe connects together emotion, or feeling, and those physical activities of the frame known as the expression or manifestation of feeling. The movements and display caused by mental excitement have been commonly regarded as merely incidental to certain of the stronger feelings, and little attention has been paid to them in the scientific consideration of the mind. For my own part, however, I look upon these active gestures as a constituent part of the complex fact of consciousness, in every form and variety. I do not say but we may have feelings that do not give rise to any visible stir of the active members, either in consequence of voluntary suppression, or because the diffused stimulus is too weak to overcome the inertia of the parts to be moved,—but I mean to affirm that *with feeling* there always is a freely diffused current of nervous activity, tending to produce movements, gesture, expression, and all the other effects described in the course of the next few pages.—See 'The Emotions and the Will,' *Emotions*, Chap. I., § 2.

'It is principally the respiratory portion of the nervous system which is involuntarily excited to the production of muscular actions by passions of the mind. Here again we see that any sudden change in the state of the brain, propagated to the medulla oblongata, immediately causes a change of action in the respiratory muscles, through the medium of the respiratory nerves, including the respiratory nerve of the face. There are no data for either proving or refuting the hypothesis, that the passions have their seat of action in a particular part of the brain, whence their effects might emanate. But these effects are observed to be transmitted *in all directions* * by the motor nervous fibres, which, according to the nature of the passion, are either excited or weakened in action, or completely paralyzed for the time.

'The exciting passions give rise to spasms, and frequently even to convulsive motions affecting the muscles supplied by the respiratory and facial nerves. Not only are the features distorted, but the actions of the respiratory muscles are so changed as to produce the movements of crying, sighing, and sobbing. Any passion of whatever nature, if of sufficient intensity, may give rise to crying and sobbing. Weeping may be produced by joy, pain, anger, or rage. During the sway of depressing passions, such as anxiety, fear, or terror, all the muscles of the body become relaxed, the motor influence of the brain and spinal cord being depressed. The feet will not support the body, the features hang as without life, the eye is fixed, the look is completely vacant and void of expression, the voice feeble or extinct. Frequently the state of the feelings under the influence of passion is of a mixed character; the mind is unable to free itself from the depressing idea, yet the effort to conquer this gives rise to an excited action of the brain. In these mixed passions the expression of relaxation in certain muscles,—in the face, for example,—may be combined with the active state of others, so that the features are distorted, whether in consequence merely of the antagonizing action of the opposite muscles being paralyzed, or by a really convulsive contraction. Frequently also, both in the mixed and the depressing passions, some muscles of the face are affected with tremors. The voluntary motion of a muscle half

* Italics mine.

paralyzed by the influence of passion is frequently of a tremulous character, in consequence of its being no longer completely under the influence of the will. We experience this particularly in the muscles of the face, when, during the sway of a depressing or mixed passion, we endeavour to excite them to voluntary action; the muscles of the organ of voice also, under such circumstances, tremble in their action, and the words attempted to be uttered are tremulous.

'The nerve most prone to indicate the state of the mind during passion is the facial;* it is the nerve of physiognomic expression, and its sphere of action becomes more and more limited in different animals, in proportion as the features lose their mobility and expressive character. In birds, it has no influence on the expression of the face; those only of its branches exist which are distributed to the muscles of the hyoid bone and the cutaneous muscle of the neck; and the erection of the skin of the neck, or, in some birds, of the ear feathers, is in them the only movement by which the facial nerve serves to indicate the passions. Next to the facial, the respiratory nerves,—those of the internal organs of respiration, the laryngeal and phrenic nerves,† as well as those of the external thoracic and abdominal muscles—are most susceptible of the influence of the passions. But when the disturbance of the feelings is very intense, all the spinal nerves become affected, to the extent of imperfect paralysis, or the excitement of trembling of the whole body.

'The completely different expression of the features in different passions shows that, according to the kind of feeling excited, entirely different groups of the fibres of the facial nerve are acted on. Of the cause of this we are quite ignorant.

'The disturbed action of the heart during mental emotions is a remarkable instance of the influence of the passions over the movements of organs supplied by the sympathetic nerve.'—p. 932-4.

12. With regard to the Movements of the Face, Sir Charles

* 'The *facial* nerve is the motor nerve of the face. It is distributed to the muscles of the ear and of the scalp; to those of the mouth, nose, and eyelids; and to the cutaneous muscles of the neck.'

† The *laryngeal* nerves are distributed to the different parts of the larynx, and are, therefore, instrumental in stimulating the voice. The *phrenic*, or diaphragmatic nerve, is the special nerve of the diaphragm.

Bell is of opinion, that many of them are secondary to the movements of respiration. He regards the heart and the lungs as the great primary sources of expression—the organs first affected by the emotional excitement of the brain.

He calls attention to 'the extent of the actions of respiration; the remoteness of the parts agitated in sympathy with the heart. The act of respiration is not limited to the trunk; the actions of certain muscles of the windpipe, the throat, the lips, the nostrils, are necessary to expand those tubes and openings, so that the air may be admitted through them in respiration with a freedom corresponding to the increased action of the chest. Without this, the sides of these pliant tubes would fall together, and we should be suffocated by exertion or passion. Let us consider how many muscles are combined in the single act of breathing—how many are added in the act of coughing—how these are changed and modified in sneezing;—let us reflect on the various combinations of muscles of the throat, windpipe, tongue, lips, in speaking and singing,* and we shall be able justly to estimate the extent of the muscles which are associated with the proper or simple act of dilating and compressing the chest. But how much more numerous are the changes wrought upon these muscles when nature employs them in the double capacity of communicating our thoughts and feelings; not in the language of sounds merely, but in the language of expression of the countenance also; for certainly the one is as much their office as the other.'

'Let us see how the machine works. Observe a man threatened with suffocation: remark the sudden and wild energy that pervades every feature; the contractions of the throat, the gasping and the spasmodic twitchings of his face, the heaving of his chest and shoulders, and how he stretches his hand and catches like a drowning man. These are efforts made under the oppressive intolerable sensation at his heart; and the means which nature employs, to guard and preserve the animal machine, giving to the vital organ a sensibility that excites to the utmost exertion.' —*Anatomy of Expression*, 3rd Edition, p. 91.

This last illustration does not decide the point as to the

* These, however, are not primitive or instinctive associations, the class that we are most interested in tracing out at present.

dependence of the contortion of the features upon the respiratory organs, inasmuch as the state of intense pain supposed would excite every part of the body by direct action. The previous remarks on the necessity there is for movements of the respiratory passages,—the throat, mouth, and nostrils,—to accompany the action of the lungs, are very much in favour of the author's view.

But that the action on the face is not wholly a consequence of respiratory excitement, is decisively proved by the expression of the eyes, for this in no way ministers to the breathing function. We are, therefore, led to conclude that, while a certain amount of the facial expression is due to the sympathy or association of the parts with the movements of the lungs, there still remains a source of independent excitement derived from the brain at first hand, and through the same common impulse that affects the respiratory, the vocal, and other organs. This distinctness of action is recognized in the passage above quoted from Müller.

13. In tracing out systematically and minutely the physical accompaniments of states of feeling, there is observable a broad and fundamental division into two classes—namely, effects of *movement* through the muscular system, and *organic* effects, or the influences exerted upon the viscera and glandular organs. Let us consider first the Movements. We find certain muscles more particularly acted on under feeling, and named, for that reason, muscles of Expression. Of those more susceptible regions, our attention is specially called to the *Face*.

The muscles of the face, whereby all the movements are sustained, are arranged round three distinct centres,—the Eyes, the Nose, and the Mouth. The mouth has the largest number of muscles, and is the most easily affected by states of feeling. The nose is the least endowed with mobility.

The muscles of the Eyebrow have been already pointed out. The *occipito-frontalis* descends over the forehead, and is inserted into the eyebrow ; this it raises or arches. It is opposed by the *corrugator supercilii*, which corrugates or wrinkles the forehead, drawing the eyebrows together. These are pre-eminently muscles of expression, although also employed as voluntary muscles for the purposes of vision. They are emotionally moved by opposite states of feeling, the one in the more pleasing emotions, the other in pain, doubt, and embarrassment; and the appearance that they cause to a spectator suggests, by association, the corresponding states of mind. The *orbicular muscle* of the eyelids, which closes the eye, is of the nature of a sphincter, like the muscle surrounding the mouth, and constituting the lips. This is opposed by the *levator palpebræ*, or the elevating muscle of the upper eyelid, which opens the eye, both voluntarily and under emotion. The *tensor tarsi* 'is a very thin, small muscle, placed at the inner side of the orbit, resting against the fibrous covering of the lachrymal sac, and behind the tendon of the orbicularis.'

'The corrugator muscle, being fixed at its inner extremity, draws the eyebrow and eyelid inwards, and throws the skin into perpendicular lines or folds, as in frowning. The occipito-frontalis will, on the contrary, elevate the brow, and wrinkle the skin transversely; which actions are so frequently repeated by most persons, and so constantly by some of a particular temperament, that the skin is marked permanently by lines in the situations just referred to. The orbicular muscle is the sphincter of the eyelids. It closes them firmly, and at the same time draws them to the inner angle of the orbit, which is its fixed point of attachment. The levator palpebræ is the direct antagonist of the orbicular muscle; for it raises the upper eyelid, and uncovers the globe of the eye. The tensor tarsi draws the eyelid towards the nose, and presses the orifices of the lachrymal ducts close to the surface of the globe of the eye. It may thus facilitate the entrance of the tears into the ducts, and promote their passage towards the nose.'—QUAIN.

14. The muscles of the Nose are, first, the *pyramidal*, 'which rests on the nasal bone, and appears like a prolongation of the occipito-frontalis, with whose fibres it is intimately connected. It extends from the root of the nose to about half-way down, where it becomes tendinous, and unites

with the compressor naris. Its chief effect seems to be that of giving a fixed point of attachment to the frontal muscle; it also wrinkles the skin at the root of the nose.'

The *common elevator of the lip and nose* lies along the side and wing of the nose, extending from the inner margin of the orbit to the upper lip. It raises the wing of the nose and the upper lip together.

The *compressor naris* 'is a thin, small triangular muscle, which lies close upon the superior maxilla and the side of the nose, being transverse from without inwards and upwards.' Contrary to its name, the principal action of it must be to expand the nostril by raising the lateral cartilage. This is an action in obvious harmony with respiration, seeing that it opens the nasal passage.

The *depressor alæ nasi* 'is a small flat muscle, lying between the mucous membrane and the muscular structure of the lip, with which its fibres are closely connected.'

Of these and other bundles of muscular fibres, traceable on the small cartilages of the nose, the only considerable or powerful muscle is the Common Elevator of the Lip and Nose, which is thoroughly under the command of the will, and produces a very marked contortion of feature, wrinkling the nose and raising the upper lip. In expressing disgust at a bad smell, this muscle is strongly brought into play, and thence it comes to be employed in expressing disgusts generally. It is, however, employed without any such intention.

15. There are nine muscles connected with the movements of the Mouth. One of them, the *orbicularis*, is single, and surrounds and forms the aperture itself; the other eight are pairs, and radiate from this as from a centre.

The *proper elevator of the upper lip* extends from the lower border of the orbit to the upper lip, lying close to the border of the common elevator of the lip and nose. When the lip is raised without raising the nose, which is not a very easy act, this muscle is the instrument.

The *elevator of the angle of the mouth* 'lies beneath the preceding, and partly concealed by it.'

'The *zygomatici* are two narrow fasciculi of muscular fibres, extending obliquely from the most prominent point of the cheek to the angle of the mouth, one being larger and longer than the other.' The elevator of the angle of the mouth, and the zygomatic muscles, serve to retract the angle of the mouth in *smiling;* they are therefore *muscles of expression.*

The two first of these four muscles are concerned in raising the upper lip, but they do not act very powerfully, or conspicuously. In fact, the upper lip is a feature remarkable for fixity, as compared with the under lip, and is not often elevated in man; and on the occasions when it is raised, this is done by the common elevator rather than by its own proper muscles.

The region of the lower jaw contains three muscles, the depressor of the angle of the mouth, the depressor of the lower lip, and the elevator of the lower lip.

The *depressor of the angle of the mouth* lies at the side and lower part of the face, being extended from the angle of the mouth to the lower jaw.

The *depressor of the lower lip* is a small square muscle, lying nearer to the middle line of the chin than the preceding, by which it is partly concealed. It arises from the fore part of the lower jaw-bone, and is inserted into the lower lip; its fibres become blended with those of the orbicular muscle of the mouth, having been previously united with those of its fellow on the opposite side.

The *elevator of the lower lip* arises from a slight pit below the teeth-sockets of the lower jaw, near the middle line of the jaw, and is inserted into the tegument of the chin, which it lifts when in action.

The remaining muscles of the mouth are unconnected with either jaw, having a sort of middle position between them.

'At each side of the face, in the part called the "cheek," is a muscle—the buccinator; and, round the margin of the mouth, one—the orbicularis oris.'

'The *buccinator* is a thin, flat plane of muscular fibres, quadrilateral in figure, occupying the interval between the jaws.' This muscle is exerted in masticating the food, and receives nerves from the same source as the masseter, which is one of the principal muscles engaged in the act of mastication.

The *orbicularis oris* 'belongs to the class of sphincter muscles, and, like them, is elliptic in form, and composed of concentric fibres, so placed as to surround the aperture of the mouth; but with this peculiarity, that the fibres are not continued from one lip into the other. The muscle is flat and thin; its inner surface being in contact with the coronary artery of the lips, labial glands, and the mucous membrane; the external with the skin and the fibres of the different muscles which converge towards the margin of the mouth.'

'The aperture of the mouth is susceptible of considerable dilatation and contraction; the former being affected by the different muscles which converge to it, and which may be compared to retractors drawing, with different degrees of obliquity, the lips, or their angles, in the direction of their respective points of attachment. The elevators are necessarily placed at the upper part of the face, the depressors in the opposite situation, and the proper retractors on each side; and these are the zygomatici and the buccinators. The buccinators also contract and compress the cheeks; this power is brought into play when any substance becomes lodged in the interval between them and the jaws.'

16. But it would be a mistake to confine the wave of movement to the Face, although this is the region where it is pre-eminent. The Voice acts in concert, giving forth sounds that are characteristically different under joy or woe, affection or rage. (The mechanism of the vocal organs is described in a separate section.) Among muscles specially affected under mental states, we should not omit the Diaphragm.

All the muscles of the body may be thrown into agitation under a wave of strong feeling; the movements, gesticulations, and carriage of the frame at any one moment are confidently referred to as proof of a certain emotional state. In Joyful moods, an abundance of gesticulation is often displayed in company with the play of the features and the voice. In Sorrow, there is sometimes a wild frantic excitement, but more commonly we observe the inaction and collapse of the moving members generally. In Wonder, there is apt to be a liveliness of movement; so in Rage; while a tremulous quaking is the characteristic of Fear.

17. I must next advert to the Organic effects of emotion, which are quite equal in point of importance to the muscular. The viscera and glandular organs that are known to be the most decisively acted on are the following:—

(1.) The *Lachrymal Gland* and *Sac*. The Anatomy of this part has been adverted to in speaking of its associated organ, the Eye. The effusion of Tears from the gland is constantly going on during waking hours. Certain states of emotion,—tenderness, grief, excessive joy,—cause the liquid to be secreted and poured out in large quantities, so as to moisten the eye, and overflow upon the cheek. By this outpouring, a relief is often experienced under oppressive pain, the physical circumstance being apparently the discharging of the congested vessels of the brain. A strong sensibility undoubtedly lodges in the lachrymal organ, the proof of a high cerebral connexion. The ordinary and healthy flow of this secretion, when conscious, is connected with a comfortable and genial feeling; in the convulsive sob, not only is the quantity profuse, but the quality would appear to be changed to a strong brine.

(2.) The *Sexual Organs*. These organs are both sources of feeling when directly acted on, and the recipients of influence from the brain under many states of feeling otherwise arising. They are a striking illustration of the fact that our emotions are not governed by the brain alone, but by that in conjunction with the other organs of the body. No cerebral change is known to take place at puberty; nevertheless, a grand extension of the emotional susceptibilities is manifest at that season. Although the organs may not receive their appropriate stimulation from without, the mere circumstance of their full development, as an additional echo to the nervous waves diffused from the cerebrum, alters the whole tone of the feelings of the mind, like the addition of a new range of pipes to a wind instrument. It is the contribution of a *resonant*, as well as of a sensitive part.

(3.) The *Digestive Organs*. These have been already fully described; and their influence upon the mental state has also been dwelt upon. In the present connexion, we have to advert more particularly to the reciprocal influence of the mind upon them. It may be doubted whether any considerable emotion passes over us without telling upon the processes of digestion, either to quicken or to depress them. All the depressing and perturbing passions are known to take away appetite, to arrest the healthy action of the stomach, liver, bowels, &c. A hilarious excitement, within limits, stimulates those functions; although joy may be so intense as to produce the perturbing effect; in which case, however, it may be noted that the genuine charm or fascination is apt to give place to mere tumultuous passion.

The influence of the feelings in digestion is seen in a most palpable form in the process of Salivation. In Fear, the mouth is parched by the suppression of the flow of the saliva: a precise analogy to what takes place with the gastric juice in the stomach.

An equally signal example in the same connexion is the choking sensation in the throat during a paroxysm of grief. The muscles of the pharynx, which are, as it were, the beginning of the muscular coat of the alimentary canal, are spasmodically contracted. The remarkable sensibility of this part during various emotions, is to be considered as only a higher degree of the sensibility of the intestine generally. The sum of the whole effect is considerable in mass, although wanting in acuteness. In pleasurable emotion even, a titillation of the throat is sometimes perceptible.

(4.) The *Skin*. The cutaneous perspiration is liable to be acted on during strong feelings. The cold sweat from fear or depressing passion, is a sudden discharge from the sudorific glands of the skin. We know, from the altered odour of the insensible or gaseous perspiration during strong excitement, how amenable the functions of the skin are to this cause. It may be presumed, on the other hand, that pleasurable elation exerts a genial influence on all those functions.

A similar line of remark would apply to the *Kidneys*.

(5.) The *Heart*. The propulsive power of the heart's action varies with mental states as well with physical health and vigour. Some feelings are stimulants to add to the power, while great pains, fright, and depression reduce the action. Müller remarks above, that the disturbance of the heart is a proof of the *great range* of an emotional wave; or its extending beyond the sphere of the cerebral nerves to parts affected by the sympathetic nerve.

(6.) The *Lungs*. The quotations above given, from Müller and Bell, sufficiently express the influence of emotional states on the *movements* of respiration. The immediate effect of increasing or diminishing the movements will be to increase or to diminish the rate of exchange of the two gases—oxygen and carbonic acid—at the surface of the lungs. We cannot show that this exchange is influenced, through the nerves, otherwise than by the altered energy of the breathing movements.

(7.) The *Lacteal Gland* in woman. Besides the six organs now enumerated as common to the two sexes, we must reckon the speciality of women, namely, the Secretion of the Milk. Like all the others, this secretion is genial, comfortable, and healthy, during some states of mind, while depressing passions check and poison it. As an additional seat of sensibility, and an additional resonance to the diffused wave of feeling, the organ might be expected to render the female temperament to a certain degree more emotional than the male, especially after child-bearing has brought it into full play.

18. The question now presents itself: can any general law be pointed out as giving a clue to this blending of physical effects with states of feeling?

A very considerable number of the facts may be brought under the following principle, namely, that *states of pleasure are connected with an increase, and states of pain with an abatement, of some, or all, of the vital functions.*

Let us first revert to the known Agents, or stimulants, of pleasurable feeling, and compare them with their opposites. Beginning with the muscular Feelings, it is known that exercise is pleasurable only when we are expending surplus energy, and thereby making the blood to course through the system more rapidly. Both the heart and the lungs are quickened by bodily exercise; while an accumulation of force, which it would be painful to restrain, finds a vent. Let the stage of fatigue, however, be reached, and let the spur to exertion be still continued, we then witness the concurring circumstances of the sense of pain, and the lowering of vital energy. When exercise is prolonged to the point of painful fatigue, there is an actual diminution in the amount of carbonic acid given off by the lungs, showing an enfeebled respiration. The action of the heart is likewise enfeebled, and thus upon two vital organs has fallen an abatement of energy. It is equally certain that the digestive power is reduced under the same circumstances.

Then, as to Muscular Repose, a feeling highly pleasurable, especially if the amount of exercise has been well adjusted to the strength, the generalization is not less applicable. What happens in resting after exertion is evidently this:—The muscles have expended all their surplus energy, and in so doing have stimulated several of the vital functions, such as the Heart, the Lungs, and the Skin. The Digestive function is not directly quickened under exercise, but rather retarded by the concentrating of the nervous currents in the muscles. Still, much good has been effected by the exalted operation of these other organs; and now, at the stage of repose, the power hitherto compelled into one exclusive direction, being set free, returns to the other parts, and especially to the Digestive functions, whose exaltation through that circumstance coincides with the pleasant sensibility of the resting posture. Thus, while in Repose we have the cessation of one vital energy, a corresponding increase takes place in several others: the organic functions generally are heightened, as the mental and the muscular activities subside.

Regarding the Sensations of Organic Life, commentary is almost superfluous. There are but few seeming exceptions to the rule, that organic pains are connected with the loss of power in some vital function, and organic pleasures with the opposite. Wounds, hurts, diseases, suffocation, thirst, hunger, nausea, are so many assaults upon our vitality. Taken in the gross, there can be no dispute as to the general tendency. As to the exceptions, the study of them, in some instances at least, serves to elucidate the principle. Cold is a painful agent; yet we know that it increases the functional activity of the muscles, the nerves, the lungs, and the digestion—depressing only one organ, the skin. We may hence infer that the skin is an organ of greater sensibility than any of these others. The stimulation is sometimes obtained without the depression, as in the reaction after a cold bath, whereby the skin recovers its tone; the whole effect is then exhilarating. When this is not so, we may still desire to procure the organic advantage, though at the expense of a skin pain; as in walking out on a cold day in winter.

Another apparent exception is the occasional absence of all pain in the sick bed; also the happy elation sometimes shown in the last moments of life. These cases prove, what we are already prepared for, by the example of muscular repose already cited, that a high condition of *all* the vital functions is not necessary to agreeable sensibility; and open up the important enquiry, which of these functions are most connected with our happiness, and which least? It is clear that great muscular energy, exerted or possessed, is not an immediate essential, although an indirect adjunct of considerable value. It is equally clear that the power of digestion, and a certain degree of animal heat, are indispensable. There are states of inanition, of indigestion, and of chillness, that would sink the loftiest spirit into despair. Thus it may be, that the comfort of the bed-ridden patient, and the placidity of the dying moments, are in a measure due to the fact, that disease has overtaken chiefly the functions that least participate in our sensitive life. Painless extinction is in this way contrasted with suffering continued through a long life. There are parts whose derangement is not felt till on the eve of a fatal issue; there are others that cannot be impaired without making the fact known, and that may work ill for many years before causing death. Even the organs most connected with mind, next to the brain, may undergo morbid changes that do not prevent them from giving their usual genial response to a pleasurable wave. Obstructed bowels will quench more happiness than certain kinds of organic disease of the intestines. The lungs are sometimes at the last stage of decay before affecting the enjoyment of the patient; while the healthiest man is distressed by partial suffocation.

When we pass from the Organic Feelings to the Sensations of the five senses, we miss the same decided coincidences. In Taste and Smell, for example, the rule might hold with those sensations that involve important vital organs as the Stomach and the Lungs, but scarcely with the proper sensibilities of the senses. A taste merely sweet, without being a relish, gives pleasure; but we cannot, in this instance, assign any marked increase of vital function. A bitter taste can even operate as a tonic. So with odours. We have sweet odours that are sickly, in other words, depressing; and although some of the mal-odours may lower the vital power, this does not always happen, and there is no proportion between the pain and the lowering of the functions.

Soft and agreeable touches have an effect on the mind somewhat analogous to agreeable warmth; but we cannot attribute the same physical consequences to the one as to the other. On the other hand, the painful smart, far from diminishing the energies, rather excites them for a time at least; so that here too the induction would appear to fail.

The pleasures of Hearing and Sight are probably accompanied with increased vital energy to some extent. When a person is brought from confinement in the dark to the light of day, there is observed a rise in the pulsation and in the breathing, which is so far in favour of the general doctrine. Still we cannot contend, that the degree of augmented vital energy corresponds always with the degree of the pleasure. In short, the principle that served us so well in summing up most of the organic pleasures and pains, does not apparently hold in the five senses. Some additional mode of action must be sought for, in order to give a complete theory of pleasure and pain. But before enquiring into this supplementary law, let us complete the survey of the facts bearing upon the one already announced, by viewing the accompaniments of feeling under another aspect.

19. Hitherto we have considered the physical *agents* of pleasure or pain, and have ascertained that in a number of cases, these are agents of bodily exaltation or depression. This does not exhaust the evidence. Another set of proofs is furnished by studying the *manifestations* under the opposing mental conditions, which will bring under review other pleasures and pains besides those arising from the Senses.

What, then, is the universally observed expression of pleasure, no matter how originating? Can it be better described than in the synonyms of the word pleasure,—such epithets as lively, animated, gay, cheerful, hilarious, applied to the movements and expression,—all tending to suggest that our energies are exalted for the time. In joyful moods, the features are dilated; the voice is full and strong; the gesticulation is abundant; the very thoughts are richer. In the gambols of the young, we see to advantage the coupling of the two facts—mental delight, and bodily energy. Introduce some acute misery into the mind at that moment, and all is collapse, as if one had struck a blow at the heart. (I leave out of account at present the one form of uproarious and convulsive grief.) A medical diagnosis would show, beyond question, that the heart and the lungs were lowered in their action just then; and there would be good grounds for inferring an enfeebled condition of the digestive organs.

But we can be more particular in our delineation. The expression of the face has been completely analyzed by Sir Charles Bell. In pleasing emotions, the eyebrows are raised and the mouth dilated, the whole effect being to open up the countenance; in painful emotions, the corrugator of the eyebrow acts according to its name; the mouth is drawn together, and perhaps depressed at the angles, by the operation of the proper muscle. Now, in the cheerful expression, there is obviously a considerable amount of muscular energy put forth; a number of comparatively powerful muscles have been prompted to contract through their entire range. Here we have a confirmation of the general principle. It might seem hard to say, why nature selected those muscles for more especial stimulation when the bodily powers respond to a thrill of pleasure. These preferences are obviously a part of our constitution. So far the case accords with our view. But turn now to the painful expression, and what do we find? An apparently mixed effect.* On the one hand, there is a relaxation of those parts that were made tense under a pleasurable wave, which is what we should expect. If this were all, the proof would be complete; the state of pain would be accompanied with loss of muscular energy in the features of the face. But this is not all. It would appear that new muscles are brought into play, for example, the corrugator of the eyebrows, the orbicular of the mouth, and the depressor of the angle of the mouth. Thus, if energy has been withdrawn from one class, another class has been concurrently stimulated. It is not then loss, but *transference*, of power that we witness. It was from looking at the matter

* 'In sorrow, a general languor pervades the whole countenance. The violence and tension of grief, the lamentations and the tumult, like all strong excitements, gradually exhaust the frame. Sadness and regret, with depression of spirits and fond recollections, succeed; and lassitude of the whole body, with dejection of the face and heaviness of the eyes, are the most striking characteristics. The lips are relaxed, and the lower jaw drops; the upper eyelid falls and half covers the pupil of the eye. The eye is frequently filled with tears, and the eyebrows take an inclination similar to that which the depressors of the angles of the lips give to the mouth.'—*Anatomy of Expression*, p. 151.

in this light, that Müller declared the selection of some muscles to be acted on under pleasure, and others under pain, as inexplicable; and Sir C. Bell spoke of the depressor of the angle of the mouth as a specific muscle in the expression of pain. A closer investigation, however, will show that even this putting forth of energy under pain, which appears so inconsistent with the general principle above enunciated, is really in keeping with that principle. It is the play of certain muscles of *small calibre*, whose contraction makes the relaxation of the larger muscles more complete. By a very slight putting forth of power, we can impart such a *pose* to the active organs generally, as enables them more thoroughly to renounce all stimulation, to disengage vital energy for behoof of the other parts. Thus, by a slight exercise of the flexor muscles of the body and the limbs, we can carry the relaxation of the extensors (the really energetic muscles) much farther than would happen by suspending their own proper stimulus. So in the face. A certain slight exertion of the corrugator of the eyebrows, perfects the relaxation of the more powerful muscle that elevates the eyebrows; the occurrence of a small stream of energy in the orbicular of the mouth, and in the depressor of the angle, assists the zygomatics and buccinators in relaxing themselves to the full. By the employment of a small force, we may be supposed to release a still greater quantity; so that, after all, the positive exertion of those muscles that operate under pain, merely co-operates in the general direction of the discharge or renunciation of energy on the whole. I venture to say, that but for this effect, they would not be stimulated at all in depressing emotions; were it not that the outlay is more than repaid by a saving, they would continue unmoved in those circumstances. Why is it that a forced sadness of the countenance makes the heart better,—that the employment of a certain amount of muscular energy serves to compose the body and the limbs to rest after fatigue? Simply that the *general mass* of muscle may attain the *maximum* of relaxation; a result gained only by the contraction of some portions. The body being moved at all points between opposing forces, we cannot relax every muscle of the body at once; the utmost we can do is to relax those that have borne the burden and heat of the day, and are the greatest in mass and energy; which necessitates the contraction of such as are opposed to them. I hold, therefore, that the tension of some members under pain does not invalidate, but rather confirms, the principle in question.

Another exception is the energetic expression prompted by acute pains. No one can say in the case of a man starting from a violent scald, that there is a relaxation of muscular energy; there is most manifestly the contrary. This seems a flat contradiction to our doctrine. In truth, however, this is the operation of another law of the constitution submerging at the moment the main principle, but only to make it emerge in still stronger relief. Sudden and acute pain is a stimulant of the motor nerves of the system. These become all alive for the instant, and throw a violent current into the moving members, inspiring a temporary spasmodic energy. Nothing could be more emphatically opposed to the doctrine here maintained than the appearance thus presented. But look at the other side of the picture. In the first place, this spasmodic burst has drawn away the regular supply of nerve force from the organic functions; all which will be found to be seriously impaired on the occasion; so that, at best, there is but a disturbance of the usually healthy direction of the vital power. And, in the next place, consider what happens at the end; how frightful the prostration that follows this painful stimulation. We shall then be convinced that, on the whole, power has been profusely sacrificed, although from the susceptibility of the nerves to an acute stimulus, there was for a time a manifestation of unusual energy.*

* 'In pain, the body is exerted to violent tension, and all the emotions and passions allied to pain, or having their origin and foundation in painful sensations, have this general distinction of character, that there is an energetic action or tremor, the effect of universal and great excitement. It must at the same time be remembered, that all the passions of this class,

20. The consideration of the two great convulsive outbursts—Laughter and Sobbing—belongs to this part of the subject.

I shall say nothing at present as to the causes of *laughter:* enough that it is a joyful expression. The principal in the case is the Diaphragm, all else is subordinate and secondary. That large muscle, which is the principal agent in the act of inspiration, its contraction increasing the capacity of the chest, is convulsed in laughter; in other words, it is made to undergo a series of rapid and violent contractions. Some great accession of stimulus from the brain has reached it, and the consequence is that the person 'draws a full breath, and throws it out in interrupted, short, and audible cachinnations.' A charge of nervous power has been generated somewhere, and is here discharged into the great muscle of inspiration. The concurring or subsidiary actions also indicate an increase of power. When the laughter is audible, we know that the vocal chords have been made tense through a stimulus applied to the muscles of the larynx. The features also participate, and put on the expansive attitude at its fullest stretch. Whether, therefore, we look at the principal, or at the accessory, movements in laughter, they alike imply that new power has been evolved somewhere; and it is next to be seen, whether this is a real addition to the general vitality, or merely a transference from one part to another, impoverishing some organs, while violently stimulating others, as we have seen to be the case in the convulsions of pain. Now, except in excessive and immoderate laughter, or unusual depression of the system, it cannot be said that any vital function is starved, through the amount of force discharged in this violent manifestation. The testimony of mankind is in favour of the genial operation of laughter; but if digestion, perspiration, the exhalation from the lungs, or the action of the heart, were weakened to supply those con-

some more immediately, others more indirectly, produce in the second stage exhaustion, debility, and loss of tone from over-exertion.'—*Anatomy of Expression*, p. 154.

vulsive movements of the diaphragm, we may be quite sure that the reaction would be unequivocally depressing, no less than that of acute pains. The proof is decisive that this outburst of joyful emotion is a sudden heightening of the powers of life, which more especially shows itself in increased and convulsive respiration, in vocal tension, and in the pleased expression of the features.

The convulsive outburst of *grief* contrasts strikingly with the above. The principal in the effect is still the convulsive action of the chest; but mark the difference. The expiration, which in the other was violently increased, is *rendered slow.* The diaphragm must answer for this fact, or rather the nervous centres that maintain it in operation. These centres, instead of overflowing, have become bankrupt; they cannot even keep up the usual supply of power. This partial stoppage, or paralysis, of the diaphragm is a key to the whole phenomenon. To prevent suffocation, the muscles of inspiration have to be stimulated by efforts, like the application of bellows to inflate the lungs of a drowning man; which forces on, by reaction, an additional expiratory impulse. The great declension of vital energy is apparent. The accessories attest the same fact. The voice is feebly exerted, and the consequence is a long-drawn, melancholy note. The pharynx is convulsed, and is incapable of its rhythmical movements in swallowing. The features are relaxed, except in so far as they sympathize with the efforts of forced inspiration. These appearances are sometimes modified, as when a robust child bursts out in a violent fit of crying, expending a great deal of energy on the occasion. Great animal spirits can afford this manifestation; and it may be little else than an outlet for surplus power, having less of sorrow than of anger. But that would not be the fair or typical instance. In all cases, the reaction shows that power has been wasted and the system impoverished, the very opposite of laughter.

The lachrymal effusion is an accompaniment of grief, but there are also tears of joy. In the extreme of merriment, the eye is moistened and suffused. We can easily suppose, that an increased vital stimulus of the lachrymal gland and sac would promote the secretion of the healthy liquid, and that this, by coursing over the sensitive surface of the eyelids, would give a certain genial sensation, which we enjoy in the happy moods of tender emotion. The amount may be increased so as almost to reach the point of visible drops, and still be of the genial character. But we must not conclude that the profuse stream that overflows in the outburst of grief, is merely the same action carried one stage farther. The common fact of abundance of liquid does not prove that all else is the same. As we may have a profuse salivation, containing very little of the material that avails for insalivating the food, so we may have a profuse lachrymal effusion, caused, not by the increased, but by the diminished action of the gland, in which case the quality would be radically changed. I make this assumption partly on speculative grounds, and partly because I think any one will recognize a difference in the sensation of the eyelids, when moistened under a joyful wave, and when the moistening comes of pain or depression.

Not only in painful states, but also in extreme instances of pleasurable emotion, the blood-vessels of the brain are congested, and the effusion of tears is one mode of relief.

21. The principle now contended for not only explains a large and important region of facts, but is essential to the preservation of the individual. If pleasure were something subversive of vital force, our system would be a house divided against itself. On the other hand, if the above principle were rigorously true, we should never be inwardly moved to act in a manner prejudicial to our physical welfare. That we are so moved is, then, a proof of the existence of some modifying influence, which must be brought to light, in order to complete the theory of pleasure and pain. It has been seen that the ordinary pleasures of the five senses do not point to any great or marked increase of vitality; and one might say the same of many of the special emotions—wonder, affection, power, knowledge, fine art, &c. That these are accompanied

by some increase of vital power is proved by their expression, which is of a lively, animated kind, whenever the pleasure is considerable. But it could not be said, that the increase of vigour in the system at large corresponds on all occasions to the degree of the pleasure. A still more startling exception is presented by the Narcotic stimulants, for these are known to debilitate and waste the powers of life. And if it be maintained that this is only an after consequence, and corresponds to the stage when the mental tone has changed to pain and depression, I reply that such is not strictly the fact; a man drinking to intoxication loses his physical energy before the feeling of exhilaration abates; and the pleasurable excitement of tobacco and of opium may continue under an almost total prostration of the vital forces.

We are thus called upon to qualify the doctrine that connects Pleasure and Self-conservation, by another doctrine connecting Pleasure simply with Stimulation. The precise limits of this second principle are to be determined by an examination of the facts.

22. It is convenient to divide the modes of stimulation into two classes: First, what may be called the natural stimulants of the Senses and the Emotions; and secondly, Narcotics and Drugs.

First. On examining the natural stimulants of the Senses, what we appear to find is this. Touches, Sounds, Sights, are pleasurable within certain limits of *intensity* (excepting perhaps discordant sounds). Pain in these three higher senses arises from excess in the stimulus applied. The point of excess is exceedingly variable in different persons, and in the same person at different times; and notoriously depends upon the vigour of the system. So that we may say with certainty, as regards the sensations of Touch, Hearing, and Sight, that sensation, as such, is pleasurable within limits determined by the vigour of the nervous system. As regards the chemical senses, Taste and Smell, we cannot lay down the rule in the same positive manner; we cannot affirm the difference between painful tastes or odours and those that are pleasant to be merely a difference of acuteness. We do not at present understand what are the distinctive modes of action of sweet and bitter tastes on the nervous substance, and we may not say, regarding tastes and odours, that sensation as such is pleasurable. At all events, these pleasures and pains are not obviously explained on the principle of Conservation : both the one and the other are referable purely to the principle of Stimulation. A bad odour does not owe its painful agency to depression of vitality, nor a sweet odour to the opposite fact.

Some of the simpler emotions can be easily explained on one or other of the two principles. Wonder is a pleasurable stimulant, if not applied out of proportion to the vigour of the system. So with tender feeling, with the sentiment of power, fine art, &c. Many of the painful emotions are associated with depressing agencies : fear, sorrow, shame, are familiar examples. These may also operate as perverse stimulants, or irritants, of the nervous system.

And now, in the second place, as regards narcotic stimulation, we have a series of substances—alcohol, tobacco, tea, opium, haschish (Indian hemp), betel-nut—that are pleasurable, but hardly in any degree favouring vital action. We may allow them some influence in promoting the physical vigour for a brief interval of time, but their effect, as stimulants of the mental tone, is out of all proportion to the most that can be claimed for them in that respect. On the other side, if carried beyond certain narrow bounds, they undermine and destroy the human constitution ; and the principle of self-conservation is not always able to avert that consequence.

The law of Stimulation, as a supplementary principle to Conservation, amounts to this :—We possess a certain amount of nervous vigour or irritability, which is converted into the full actuality of pleasure, only when impelled by shocks that have no nutritive tendency, but merely draw upon, and consume, the accumulated power. If we apply stimulants, up to a certain point, we do not dissipate force beyond what will be repaired; if we fall short of that point, we miss the pleasure that our frame is able to sustain; if we exceed the point, we run into a declension or degeneracy. It would seem that we can afford both the natural stimulation of the senses, and a certain small amount of stimulating drugs, and yet not over-draw our allowance of nervous power.

23. One might, not without plausibility, maintain the position that Stimulation is the sole cause of pleasure, and that the nourishment of vital energy merely enables this to be pushed to greater lengths, without degenerating into pain. The facts would undoubtedly bear this interpretation. It could be said that stimulation of some kind can never be absent; and that, by increasing the vital power, this stimulation, falling on the refreshed nervous substance, would impart the pleasurable tone. But it is better, in the present state of our knowledge, not to push either principle to exclusive predominance. A certain physical vitality, in some organs at least, if not an essential condition of a pleasurable tone, can always enhance the effect of the other cause, and in practice is often all that we need to look to.

The contrast of country and city life familiarly illustrates the two principles. The pleasure of the one results mainly from the conservative and healthy or vitalizing influences, the pleasure of the other from variety of stimulation. It is possible to attain a measure of happiness by either mode. High health is not an essential of pleasure; the nerves may respond to agreeable stimulations in the midst of some (not all) modes of bodily weakness. The readiness to take on the thrill of intense pleasure is a *speciality* of the nervous constitution; the state of the general system, and more particularly of the glandular organs, is an important element, but the main foundation is to be sought in an endowment of, in the case, the nerve tissue. A man may have, as it were, a natural genius for being happy. (For a further discussion of the physical accompaniments of Feeling, see Appendix B.)

THE INSTINCTIVE GERMS OF VOLITION.

24. In a former chapter, I endeavoured to establish, as an important fact of the human system, that our various organs are liable to be moved by a stimulus proceeding from the nervous centres, in the absence of any impressions from without, or any antecedent state of feeling whatsoever. This fact of spontaneous activity, I look upon as an essential prelude to voluntary power, making indeed one of the terms or elements of Volition; in other words, Volition is a compound, made up of this and something else.

Neither the existence of spontaneous actions, nor the essential connexion of these with voluntary actions, has been, so far as I am aware, advanced as a doctrine by any writer on the human mind; but the following interesting extracts from the great physiologist, Müller, will show that he has been forcibly impressed with both the one and the other of these views.

'It is evident that the ultimate source of voluntary motion cannot depend on any conscious conception of its object; for voluntary [I should say 'spontaneous,'] motions are performed by the fœtus before any object can occur to the mind, before an idea can possibly be conceived of what the voluntary motion effects; we must therefore view the question in a much simpler manner. On what do the first voluntary movements in the fœtus depend? All the complex conditions which give rise to voluntary motions, in the adult, are here absent. Its own body is the sole world from which the obscure conceptions of the fœtus that excite its actions can be derived. The fœtus moves its limbs at first, not for the attainment of any object, but solely *because it can move them.* Since, however, on this supposition, there can be no particular reason for the movement of any one part, and the fœtus would have equal cause to move all its muscles at the same time, there must be something which determines this or that voluntary motion to be performed,—which incites the retraction, first of this foot or arm, and then of the other.'

This last supposition, as to the equal tendency of all the muscles to come into action through the spontaneous activity of the centres, is, I think, too absolutely stated. There can hardly exist such a perfectly balanced charge of the centres, as to make all of them equally ready to commence a stimulus of the muscles under their control, like the ass of Buridan between the two bundles of hay. It will always happen that some one will be more prone to act than another, from the mere state of constitutional or nutritive vigour belonging to it: and when that one has exhausted itself, the discharge of some other may be expected. Then, as to the tendency to move the limbs by turns, we have already seen that this alternation is provided for by a distinct arrangement; so that when by any means a motion of the legs is commenced, that motion is guided in an alternating cycle. I continue the quotation from Müller.

'The knowledge of the changes of position, which are produced by given movements, is gained gradually, and only by means of the movements themselves; the first play of the will on single groups of the radicle motor fibres of the nerves in the medulla oblongata, must therefore be independent of any aim towards change of position; it is a mere play of volition, without any conception of the effects thereby produced in the limbs. This voluntary [say, rather, spontaneous] excitation of the origins of the nervous fibres, without objects in view, gives rise to motions, changes of posture, and consequent sensations. *Thus a connexion is established in the yet void mind between certain sensations and certain motions.* When subsequently a sensation is excited from without, in any one part of the body, the mind will be already aware that the voluntary motion, which is in consequence executed, will manifest itself in the limb which was the seat of sensation; the fœtus in utero will move the limb that is pressed upon, and not all the limbs simultaneously. The voluntary movements of animals must be developed in the same manner. The bird which begins to sing, is necessitated by an instinct to incite the nerves of its laryngeal muscles to action; tones are thus produced. By the repetition of this blind exertion of volition, the bird at length learns to connect the kind of cause with the character of the effect produced.

'We have already learned, from many other facts, that the nervous principle in the medulla oblongata is in a state of extraordinary tension, or proneness to action; that the slightest change in its condition excites a discharge of nervous influence, as manifested in laughing, sneezing, sobbing, &c. While the tension of the nervous principle is not disturbed, we are equally ready to excite voluntary movements in any part of the body, and such is the state of rest or inaction. Every mental impulse to motion disturbs the balance of this tension, and causes a discharge of nervous influence in a determinate direction,—that is, excites to action a certain number of the fibres of the nervous motor apparatus.'—(Physiology, p. 936-7.)

This last view I conceive to be an accurate statement of the nature of nervous energy. The nervous system may be compared to an organ with bellows constantly charged, and ready to be let off in any direction, according to the particular keys that are touched. The stimulus of our sensations and feelings, instead of supplying the inward power, merely determines the manner and place of the discharge. The centres of speech and song, for example, when fresh and healthy, either overflow so as to commence action in a purely spontaneous way, or they remain undischarged till irritated by some external influence, as, for example, the sound of another voice. The bird whose morning song has lain dormant for a time, breaks forth at the stimulus of another songster just begun.

25. We must now, therefore, specifically consider what there is in volition over and above the spontaneous discharge of active impulses upon our various moving organs,—limbs, body, voice, tongue, eyes, &c. If we look at this kind of impulse closely, we shall see wherein its defect or insufficiency lies, namely, in the random nature of it. Being dependent on the condition of the various nervous centres,

the discharge is regulated by physical circumstances, and not by the ends, purposes, or uses of the animal. When the centres of locomotion are fresh and exuberant, as in the dog unchained of a morning, the animal sets off at the top of his speed; the force once exhausted, the creature comes to a stand-still in the same spontaneous way, like a watch run down. But this moment of exhausted energy is the very moment when an animal ought properly to be active in procuring food and replenishment to the system; and there ought to be in the state of exhaustion itself a stimulus to act, just as a watch run down would require, in order to be self-sustaining, to pull some string that would set a-going a power to wind it up, or as a dying fire ought to act on a spring for putting on fresh coals. Mere spontaneity, therefore, stops far short of what our volition does for us in the way of self-preservation; a power that dies out when action is most needed, cannot be the appropriate support of our existence.

Müller's application of the term 'voluntary' to the initial movements prompted solely by the state of tension of the nerve centres, is not strictly correct; these movements are but one term of the couple that makes up an act of volition; both a feeling and a movement are necessary parts of every such act. A morsel of food on the tongue stimulates the movements of mastication; this is a voluntary effort, an effort prompted and controlled by a feeling, namely, the sensation of taste or relish. Acts performed without any stimulus of feeling are usually described as involuntary; such are the spasms of disease, and many of the reflex movements.

There is, in the mature animal, a power in certain feelings or emotions to originate movements of the various active organs. A connexion exists between our emotional states and our active states, sufficient to constitute a link of cause and effect between the one and the other. The question is whether this link is original or acquired.

Dr. Reid has no hesitation in classing the voluntary command of our organs, that is, the sequence of feeling and action implied in all acts of will, among instincts. (See his chapter on Instincts, *Essays on the Active Powers.*) The power of lifting a morsel of food to the mouth is, according to him, an instinctive or pre-established conjunction of the wish and the deed; that is to say, the emotional state of hunger coupled with the sight of a piece of bread, is associated, through a primitive link of the mental constitution, with the several movements of the hand, arm, and mouth, concerned in the act of eating.

This assertion of Dr. Reid's may be simply met by appealing to the facts. It is not true that human beings possess at birth any voluntary command of their limbs whatsoever. A babe of two months old cannot use its hands in obedience to its desires. The infant can grasp nothing, hold nothing, can scarcely fix its eyes on anything. Dr. Reid might as well assert that the movements of a ballet-dancer are instinctive, or that we are born with an already established link of causation in our minds between the wish to paint a landscape and the movements of a painter's arm. If the more perfect command of our voluntary movements be an acquisition, so is the less perfect command of these movements during the first year of life. At the moment of birth, voluntary action is all but a nonentity.

26. Accordingly, there must be a process of *acquirement*, in the establishing of those links uniting feeling with action, which volition implies. But the acquisition must itself repose upon some primordial fact, or instinct, of our nature. The point, then, is to ascertain what connexion there is, at the outset of life, between our feelings and our movements, which the course of experience and education converts into mature volitions.

I will endeavour to indicate what seems to me the precise situation wherein a feeling prompts an action in the beginning.

Although in the completely-formed will, a state of pleasure can induce the actions necessary for prolonging it,—as when a crowd follows a military band,—in the infancy of the being, pleasure can induce action of *some kind*, but not necessarily of the right kind. There is no relevance in the heightened movements of the child under pleasure, no proper direction given to them for sustaining or increasing that pleasure, as would happen at a later period. Still, there is an effect of quickened energy when an agreeable feeling suddenly takes possession of the mind. We have seen that an increase of vital power is a concomitant of pleasure, (this holds even under the principle of Stimulation); which increase passes sometimes to the organic functions alone, and sometimes to the active functions or the muscles, and not unfrequently to all parts, especially in the freshness of early life. Now, the important result as regards the will, is the *muscular* accession. If the system is previously quiescent, there will be a burst of energy; if already acting, the action will be increased. Still there will be no determination in one course rather than in another; there will be no preference, and therefore no proper volition.

Suppose now that the movements arising out of mere physical exuberance, should be accidentally such as to increase the pleasurable feeling of the moment; the very fact of such increased pleasure would imply the other fact of increased energy of the system, *and of those very movements then at work.* The pleasure would in this way feed itself, and we should have something amounting substantially to a volition. Spontaneity, or accident, has brought certain movements into play; the effect of those movements is to induce a burst of new pleasure: but we cannot induce pleasure without inducing new energy to the physical system, and therefore to the members acting at the moment. So long as these movements add to the pleasure, so long they add to their own stimulation. Let them cease to yield new accessions of delight, and there will be an end to their farther acceleration as the result of increased vital energy.

27. Before producing actual instances, let us complete the general statement by supposing the opposite condition, that is, Pain. Let movements be commenced as before, through the spontaneous energy of the healthy system, but

let those movements occasion a sudden feeling of pain. In doing so, they occasion also, in virtue of the connexion above contended for, an abatement of the vital energies, which abatement, extending to the movements, brings them more or less to a stand-still. (To avoid complicating the case at this stage, I must suppose that the pain is not an acute smart, which would irritate the nerves and induce the spasmodic movements of pain; that is no doubt a genuine natural agency, but as it is not of universal occurrence, we can here assume that it does not take place. In following out the consequences of pain as such, the depression of the powers of life is the chief, and the only indispensable, effect.) But this effect is exactly what is wanted in the present instance, namely, to check movements that are the cause of suffering; and the end is, for the time being, as much answered through the agency in question, as it is afterwards when the will attains its full development. If a cessation of active energy is the remedy for a state of suffering, that remedy lies in the fact itself; for suffering and abated force go together. The application of this fact is peculiarly apparent in the modes of dealing with men and animals. If we wish to repress too much activity in a living being, pain is the sure instrument. A slight pain, no doubt, may have the opposite effect, for reasons that we have seen; but a severe pain will certainly succeed. The natural, the direct agency of pain is to abate vital power, muscular action included. The instantaneous consequence of even a slight hurt is often to stop activity for the instant. Thus, then, we see that when movement concurs with pain, the pain arrests the movement through its general depressing agency; as, on the other hand, a movement bringing pleasure is sustained and promoted through the connexion between pleasure and exalted energy.

28. Take the example of sucking, an act that the infant, or young animal, must be capable of at the moment of birth. At the outset, there must be a reflex process, causing the embrace of the nipple to be followed by the movements of the tongue. The voluntary stage is attained, when the feeling of

pleasure can operate to sustain the action once commenced. But how does this feeling possess the power to induce the continuance, perhaps to heighten the energy, of the act? I conceive it is by the contact of the nutritive material with the stomach elevating all the powers of life, including the moving members in actual operation, namely, the chest, tongue, and mouth. To put forth additional energy in masticating, swallowing, &c., when the food is agreeable to us, is a voluntary power at any time of our life. Let us now suppose that the point of satiety is reached, and that the child gives over of its own accord at that point. The meaning, then, plainly is, that the contact of the liquid with the full stomach is no longer stimulating to the powers of life; that, in fact, if persisted in, the contrary result ensues. The wave of energy extending to the sucking parts now fades away, and they themselves fall into inaction; in other words, the infant ceases just as if it knew that it had enough; the fact being, that the painful state of mind called satiety, is accompanied with a lowered condition of the active organs, which ultimately arrests the movement that is causing the satiety; *not, however, as in after life, by specially withdrawing power from that part, but by the round-about process of cutting off power at all points.* The primordial force of volition knows nothing of singling out one member from the rest; this comes by a series of tentatives and early struggles. Pleasure can raise the energy everywhere, pain lower it everywhere, from the first; the power of discriminative selection is not born with us, and must be acquired.

I have supposed the case of a pleasure concurring with a movement that feeds it; and of a pain concurring with a movement that occasions it; and have pointed out the natural results. A third case, of equal, if not greater, frequency in animal life, is the following:—A creature is in pain, or under a depressing condition of mind; the direct consequence, or natural accompaniment, is a lowered state of the vital energies. Nevertheless random movements are still performed; the spontaneity may not be exhausted; and perhaps the pain has produced that other effect of spasmodic irritation of the nerves. At all events, movements occur; the limbs are thrown about, the head is tossed from side to side, and so on. Now, let the pain instantly cease. Mentally, the result is a great reaction, in fact a burst of pleasure; physically, there concurs the usual elation of the system, moving members among the rest. The movements that were going on when the pain ceased, receive a sudden accession of power out of the general fund, and are made all the more energetic. Apply this to a particular instance. A new-born animal lies on the ground uneasy. It knows nothing of the cause and as little of the remedy. The physical accompaniment of the state is a languid condition of the bodily members, supposing no acute stimulation of the nerves. Still the moving energies are not entirely subdued. The spontaneous tendencies, prompting now to one part, now to another, make it at last spring to its legs and commence a forward locomotion. With the locomotion, the uneasiness sensibly subsides. Say that the animal is thereby withdrawn from too great proximity to the fire. Now, every felt abatement of the uneasy sensation is a throb of pleasure, and carries with it the usual physical stimulation. The inevitable consequence is, that the locomotive movement accidentally begun shares in the heightened energy imparted to the system, concurrently with the relief from the pain, and is consequently quickened. If the relief still goes on, so does the stimulation, until the uneasy state has passed away even from the remembrance; at which stage no further increase takes place, and the animal, after giving full vent to the energy thus imparted, falls away again to the resting posture. If, however, in avoiding Scylla, the creature were to come upon Charybdis, the course would be reversed; a new pain encountered would have its effect in arresting action; a pain increasing at every step would accelerate the downward career of depression, until movement were no longer possible.

To take another example. An infant lying in bed has the painful sensation of chillness. This feeling has its usual depressing accompaniments, and may or may not cause the convulsive outburst of pain, what we may term the characteristic *emotional* expression. At all events, spontaneous movements will arise, whether from natural healthy power, or from irritated nerves. In the course of these spontaneous movements, there occurs an action bringing the child into contact with the nurse lying beside it; instantly, warmth is felt, there is a throb of pleasure, and a concurrent stimulus to the physical system. The successful movement is sustained, and made more energetic, and the contact is kept up. Such would be the natural operation of the law that connects pleasurable relief with increased energy. The child twelve months old can perform this act by a true selective volition: the child of three days can do it only at random, and by the help of the principle we have been explaining. A process of acquirement has, I believe, occurred in the meantime, which is exemplified in the present volume (CONTIGUITY, *Associations of Volition*), and at still greater length in 'The Emotions and the Will' (WILL, Chap. II.).

29. There are various actions, commonly called Instincts, that are only phases or results of this fundamental property of mind. *Self-preservation,* implying the revulsion from pain and injury, and the appropriation of the means of subsistence, is an example of volition as now explained. We have apparently no original tendency to protect ourselves from injurious influences, if they do not affect us as pains, nor to lay hold of beneficial influences that give no present pleasure.

Certain special instances of early precaution against harm are often remarked upon, as a portion of the original provision of nature in our behalf. Thus *the dread of falling* is very strong in early life, and stimulates powerful efforts by way of prevention. But this is no other than an instance of volition in general. The remembrance of the acute pain of a past fall is a motive to preserve the stability of one's footing. And even still earlier, and before experienced hurts can operate as a warning, there is a severe and distressing sensation in the sudden loss of support, which prompts us to exertion for restoring the firm position.

THE VOICE.

30. So deeply does the power of Speech enter into the operations of Mind—Feeling, Action, and Intelligence—that the mechanism of the organ deserves a full description.

I shall first make a few quotations from the Anatomy of the Voice.

'The upper part of the air passage (from the lungs) is modified in its structure to form the *organ of voice*. This organ, named the larynx, is placed at the upper and fore part of the neck, where it forms a considerable prominence in the middle line. It lies between the large vessels of the neck, and below the tongue and hyoid bone, to which bone it is suspended.'

'The larynx is cylindrical at the lower part, where it joins the trachea (or windpipe), but it widens above, becomes flattened behind and at the sides, and presents a blunted vertical ridge in front.

'The larynx consists of a framework of cartilages, articulated together and connected by proper ligaments, two of which, named the *true vocal cords*, are immediately concerned in the production of the voice. It also possesses muscles, which move the cartilages one upon another, a mucous membrane lining its internal surface, numerous mucous glands, and lastly, blood-vessels, lymphatics, and nerves, besides cellular tissue and fat.'

Cartilages of the Larynx.—'The cartilages of the larynx consist of three single and symmetrical pieces, named respectively the *thyroid cartilage*, the *cricoid cartilage*, and the *cartilage of the epiglottis*, and of six others, which occur in pairs, namely, the two *arytenoid cartilages*, the cornicula laryngis, and the cuneiform cartilages. Of these, only the thyroid and cricoid cartilages are seen on the front and sides of the larynx (see fig. 11, p. 309); the arytenoid cartilages, surmounted by the cornicula of the larynx, together with the back of the cricoid cartilage, on which they rest, form the posterior wall of the larynx, whilst the epiglottis is situated in front, and the cuneiform cartilages on each side of the upper opening.'—QUAIN.

Confining ourselves as much as possible to the parts immediately connected with voice, we need to refer principally to the thyroid and cricoid cartilages, the two arytenoid cartilages, the true vocal cords, and the muscles that move the cartilages and thereby affect the tension and the position of the vocal cords.

'The *thyroid* (shield-shaped) cartilage (see fig. 10) is the largest of the pieces composing the larynx. It is formed by two flat lamellæ united in front at an acute angle along the middle line, where they form a vertical projection which becomes gradually effaced as it is traced from above downwards. The two lamellæ, diverging one from the other backwards, embrace the cricoid cartilage, and terminate posteriorly by two thick projecting vertical borders, separated widely from each other; hence the thyroid cartilage is altogether wanting behind. The angular projection on the anterior surface in the median line is subcutaneous, and is much more prominent in the male than in the female, being named in the former the *pomum Adami*.'

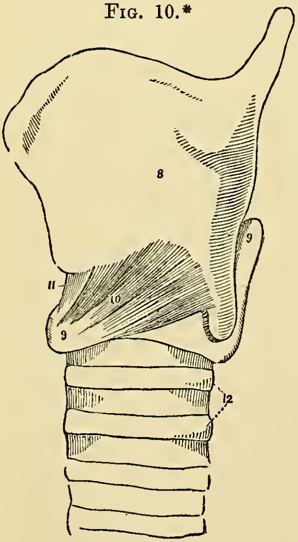
'The *cricoid* cartilage, so named from its being shaped like a ring, is thicker in substance and stronger than the thyroid cartilage; it forms the inferior, and a considerable portion of the back part of the larynx, and is the only one of the cartilages which completely surrounds this organ. It is deeper behind, where the thyroid cartilage is deficient, measuring in the male about an inch from above downwards, but is much narrower in front, where its vertical measurement is only two lines and a half. The cricoid cartilage is circular *below*, but *higher* up it is somewhat compressed laterally, so that the passage through it is elliptical, its antero-posterior diameter being longer than the transverse.'

'The *arytenoid* (ewer-shaped) cartilages (fig. 11) are two in number, and perfectly symmetrical in form. They may be compared to two three-sided pyramids recurved at the summit, measuring from five to six lines (half an inch) in height, resting by their bases on the posterior and highest part of the cricoid cartilage, and approaching near to one another towards the median line. Each measures upwards of three lines in width, and more than a line from before backwards.'

The cartilages are bound together by ligaments, of which I omit the description. The appearance of the *interior* of the larynx is given as follows (see fig. 11):

'On looking down through the superior opening of the larynx (where it communicates with the pharynx above and is bounded by the epiglottis, &c.), the air passage below this part is seen to become gradually contracted, especially in its transverse diameter, so as to assume the form of a long narrow fissure running from before backwards. This narrow part of the larynx is called the *glottis*. Below it, at the upper border of the cricoid cartilage, the interior of the larynx assumes an elliptical form, and lower down still it becomes circular. The glottis is bounded laterally by four strongly marked folds of the mucous membrane, stretched from before backwards, two on each side, and named the *vocal cords*. The *superior* vocal cords are much thinner and weaker than the inferior, and are arched or semilunar in form; the *inferior* or *true* vocal cords are thick, strong, and straight. Between the right and left inferior vocal cord is the narrow opening of the glottis, named the *rima glottidis*, and sometimes the *glottis vera* or *true glottis*.'

Fig. 10.*



The inferior or true *vocal cords*, by whose vibration the voice is produced, are two bands of elastic substance, attached in front to about the middle of the depression between the wings of the thyroid cartilage, and behind to the arytenoid cartilages; from this connexion they are called thyro-arytenoid ligaments. They consist of closely arranged parallel fibres of that peculiar tissue occurring in some other parts of the body, named the *yellow elastic tissue*, being probably the most perfectly elastic substance of a ligamentous kind that nature has produced. India-rubber is em-

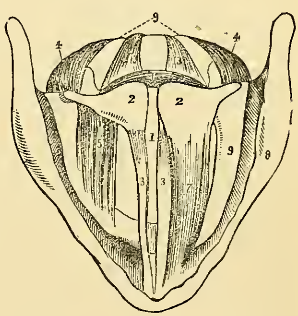
* 'Side view of the thyroid and cricoid cartilages, with part of the trachea; after Willis.—8. Thyroid cartilage. 9. 9. Cricoid cartilage. 10. Crico-thyroid muscle. 11. Crico-thyroid membrane, or ligament. 12. Upper rings of the trachea.'—(Quain.)

ployed, as an extremely inferior imitation, in making artificial instruments resembling the larynx. The upper and free edges of the cords, which are sharp and straight, are the parts thrown into vibration during the production of the voice.

31. With reference to the *muscles* of the larnyx, we may state beforehand that the principal movements to be effected by them relate to the change of tightness and the change of distance of the two chords, for which purposes opposing pairs are necessary. By one action, the chords are tightened; by another relaxed; by a separate action they are approximated, and by the antagonist of this they are parted asunder.

The great muscle of tension of the cords, the chief and the most powerful of all the muscles of the voice, is the *crico-thyroid*, exhibited in the figure. 'It is a short, thick triangular muscle, seen on the front of the larynx, situated on the fore part and side of the cricoid cartilage. It *arises* by a broad origin from the cricoid cartilage, reaching from the median line backwards upon the lateral surface, and its fibres, passing obliquely upwards and outwards, and diverging slightly, are *inserted* into the lower border of the thyroid cartilage.' The contraction of the two crico-thyroid muscles causes the thyroid and cricoid cartilages to turn on each other behind; thus, if we suppose the cricoid cartilage to remain fixed, the upper part of the thyroid is carried for-

Fig. 11.*



* 'A diagram, slightly altered from Willis, showing a bird's-eye view of the interior of the larynx.—1. Opening of the glottis. 2. 2. Arytenoid cartilages. 3. 3. Vocal chords. 4. 4. Posterior crico-arytenoid muscles. 5. Right lateral crico-arytenoid muscle; that of the left side is removed. 6. Arytenoid muscle. 7. Thyro-arytenoid muscle of the left side; that of the right side is removed. 8. Upper border of the thyroid cartilage. 9. 9. Upper border and back of the cricoid cartilage. 13. Posterior crico-arytenoid ligament.'—Quain.

ward or away from the other, drawing with it the ends of the vocal chords, which are attached behind to the cricoid cartilages through the arytenoid (see fig. 11). In this way the vocal cords are stretched in proportion as the muscle contracts itself. The counteracting or antagonistic muscles are exhibited in the fig. (7), passing between each arytenoid cartilage and the thyroid, near the extremity of the vocal cords.

For governing the aperture of the glottis, we find a muscle passing between the two arytenoid cartilages (6); by its contraction drawing them together, and thus approximating the cords. The cords are separated, and the glottis widened, by a pair of muscles, exhibited in the figure (4, 4), passing between the arytenoid and cricoid cartilages behind. No. 5 in the figure is another muscle connecting the same two cartilages laterally, and operating to contract the glottis.

32. *The Larynx, considered as an instrument for the production of sound.*—From the existence of two vibrating strings or cords, the first and obvious supposition, with regard to the Larynx, was to rank it with stringed instruments, such as the violin, where the same string produces a higher or lower note, according to the degree of tightness given to it. But that two strings, about an inch long, should so vary in tension as to give out a range of notes extending to more than two octaves, is altogether unparalleled in the experience of stringed instruments. A more accurate comparison appears to hold with *reed instruments,* such as the pipe of an organ, where the sound is produced by a vibrating reed. Müller imitated the human voice by stretching two elastic membranes across the mouth of a short tube, each covering a portion of the opening, and having a chink left between them. By prolonging the membranes downward into the tube, so that not merely their edges, but their whole planes, might be thrown into vibration, Mr. Willis carried still farther the imitation of the human Glottis. From experiments on an artificial glottis thus formed, it appeared that various notes could be obtained by altering the tightness of

the tongues: the more tense they are, the higher is the note produced. 'It is true that a scale of notes, equal in extent to that of the human voice, cannot be obtained from edges of leather; but this scale is much greater in india-rubber than in leather; and the elasticity of them both is so much inferior to that of the vocal ligaments, that we may readily infer that the greater scale of the latter is due to its greater elastic powers.' It is also found that in membranous tongues the increased strength of the blast can somewhat raise the pitch, the tension remaining the same.

I quote the following summary of the action of the voice, from a paper in the Proceedings of the Royal Society (June 19, 1862), by Mr. John Bishop, containing the results of actual inspection of the movements of the vocal cords, with the aid of the *Laryngoscope* of Czermak:—

'In ordinary breathing the glottis is wide open, and the arytenoid cartilages are thrown wide apart; but on the production of the most simple sound, these cartilages are suddenly and rapidly closed, and the edges of the vocal cords come into juxtaposition with each other, so as to leave no interval between them in their entire length.

'In the production of the lower tones of the voice, the vocal cords may be seen to vibrate throughout their whole length, and even at their prolongations at the base of the arytenoid cartilages; they seem to vibrate also throughout their entire breadth. As the pitch of the tones rises in the scale, the length of the cords in a state of vibration diminishes, and they are pressed more closely against each other: as the tones become more acute, the pressure is increased, and the tension of the vocal cords augmented; the breadth of the cords is also diminished.

'When the chest tones have arrived at the limit of the scale of acute range, and the falsetto tones commence, the glottis is seen to be more closely pressed together, and the edges only of the vocal cords are suffered to vibrate, as Garcia has already observed. On the other hand, while the chest tones are produced, a larger surface of the vocal cords is in a state of vibration. When the falsetto tones are produced, it appears that the very extreme edge only of the cord vibrates, and a much less expenditure of breath is required. While the highest notes of the voice are intoned, the vocal cords are so closely pressed together, that a small portion only of the glottis is seen to yield to the pressure, which takes place nearly at its central portion.

'From the inspection of the vocal organs now so easily obtained, it may be stated in general terms that, as the voice ascends from its lowest to its more acute tones, the lengths of the vibrating portions of the vocal cords are proportionally diminished, while at the same time their tensions are increased : and, in fact, they present the same phenomena as those of musical cords, and they appear to obey the same laws, as Ferrein so long since supposed, and which have since been confirmed by Müller and by myself.

'Moreover, the vocal cords form a kind of valve, which is situated in a tube, and acts on the column of air in the manner of a reed.

'It is observed that while the pitch of the tones of the voice becomes more grave, the epiglottis is depressed and the pharynx is relaxed; and, on the contrary, as the pitch becomes more acute, the epiglottis is raised and the pharynx becomes contracted: the depression of the epiglottis probably assists in deepening the pitch of the vocal tube in the same manner as the lid of an organ pipe does.

'In the production and modulation of the voice, it is astonishing with what accuracy some persons are able to produce at will, sounds of a determinate pitch and of a quality which charm and captivate the ear of a musician. The muscles which are principally concerned in this faculty are the thyro-arytenoid and the lateral crico-arytenoid. The crico-thyroid is limited to stretching the vocal ligaments.

'The mere turning of the vocal cords on their axes, out of the vocalizing position, does not afford sufficient space for ordinary breathing, as supposed by Mr. Willis, but we find that the arytenoid cartileges and vocal cords are widely separated during ordinary breathing.

'With regard to the controversy as to whether the vocal organs are to be considered as a stringed instrument or as a reeded pipe, it has been thought by some physiologists that the same organs cannot possibly perform the offices of both. However, under the denomination of reeded pipes, we find a great variety of form and structure, and it is not difficult to conceive that while the time of an oscillation of the vocal ligaments obeys the same laws as musical strings, the valve of the glottis in opening and closing the vocal tube performs an action resembling that of some of the musical reeds.

'The human organs of voice have been considered by a great many distinguished philosophers as constituting a reeded instrument, and the relation in which they stand to instruments of that character has been already discussed in my paper in the 'Transactions' of the Royal Society for the year 1846; it only remains to remark that the phenomena brought to light by means of the laryngoscope tend to confirm the idea that the vocal organs really perform the double effect both of reed and string.

'In ejaculatory sounds, such as the production of the syllables há, há, há in laughing, the glottis is opened at each intermission and closed at each intonation of sound, thus producing a rapid succession of opening and closing the glottis.'

The difference between the male and the female voice is due to the size of the larynx and the length of the vocal cords; both which are greater in the male. In persons of the same sex, there are gradations in these particulars.

33. The musical voice depends on the action of the vocal cords, in conjunction with the other parts of the larynx; the cranium also operating as a resounding mass. The *articulate* voice contains, in addition, the workings of the mouth, tongue, and nostrils. Articulation may involve the musical voice, or the action of the cords; it may, also, be toneless. In a whisper there is no musical sound. We may exert the voice to a considerable degree of loudness, without introducing tones, in which case, the supposition is that the windpipe is made vocal by its rings or other parts, and not by the usual medium of the cords. Such toneless speech involves a great expenditure of power, as well as the propulsion of a great volume of air, and is, for that reason, as well as on other grounds, avoided.

The articulate sounds are commonly divided into vowels and consonants, but the division is not founded on any broad line of demarcation. Certain letters have come to be called vowels, and others to be called consonants.

The following experiment illustrates the nature of *vowel* formation :—

'Open the mouth to its greatest possible extent—with the lips naturally drawn back, so that the edges of the teeth are visible—and emit an utterance of voice; it will sound, *ah!* Continue sounding this vowel while you *cover the mouth* firmly with the hand, laying the fingers of the left hand on the right cheek, and slowly bringing the whole hand across the mouth; the vowel quality of the sound will be changed with every diminution of the vocal aperture, progressively becoming *uh, aw, oh, oo,* as the hand gradually covers the mouth.'—Bell's *Elocutionary Manual,* p. 21.

The changes of the mouth for different vowels are chiefly two, expressed by the terms *buccal* and *oral,* the one referring to the size of the cavity of the mouth, the other to the opening of the lips. The modifications of these, coupled with the position of the tongue, give rise to all the varieties of vowel sound. An estimate has been made of the comparative dimensions of the two openings in the principal vowels. Admitting five degrees of size, both of the opening of the mouth and of the space between the tongue and palate, Dr. Carpenter, slightly altering from Kempelen, states the dimensions of these parts for the different vowels as follows :—

Vowel.	*Sound.*	*Size of oral opening.*	*Size of buccal cavity.*
a	as in *ah*	5	5
a	as in *name*	4	2
e	as in *theme*	3	1
o	as in *cold*	2	4
oo	as in *cool*	1	5

Of the *consonants* a great many divisions have been made. A certain play of the tongue, teeth, or lips is necessary in all of them. This play may vary from the mere quiver of the tongue in sounding *s,* to the forcible shutting off of the sound by the sudden closure of the lips in *p* final. The sounds *p, t,* and *k,* are connected either with sudden closures or with explosive openings of the vocal current, and are called *mutes* and also *explosive* letters. Of the three, *p* being formed by the lips, is called a *labial; t* being formed by the contact of the tongue with the palate, is a *palatal* and also a *dental;* and *k* is a *guttural* or throat-formed letter, the contact of the tongue being much farther back in the palate. As all the consonants are formed more or less nearly in one or other of these three positions, a general division of them can be made into labials, palatals, and gutturals. Six distinct Labials are enumerated, depending on different ways of sounding with the lip closure. The mute or explosive *p* has been mentioned; next to it is *b*, produced by a less violent closure, which allows the voice to be heard during the act, as any one will feel by sounding *cup* and *cub*. The third labial is *m*. This is a nose sound; the friction of the air on the nasal cavities gives the humming character; and the closure of the lip distinguishes it from the other nose sounds; it is therefore the *nasal* labial, while *b* is called the *vocal* labial. The fourth labial is *f*, produced by the upper teeth and the lower lip coming together, and the breath passing through them without voice; this is the whispered or *aspirate* labial. When voice is heard through this last closure, we have *v*, or the second vocal labial, called the *vocal aspirate*. Lastly, a sound may be emitted through the closed lips, making them vibrate or shake like a reed, as in the sound *prr:* this is the *vibrating* labial, or the labial *r*. A similar series can be described in the Palatals. The mute being *t*, the vocal is *d;* there are two forms of the nasal, *n* and *l;* the aspirates are *th* (*th*umb), *s*, *sh*, arising from slightly differing positions of the tongue in its contact with the palate; the vocals, or audible forms of these, are *th* (*th*y), *z*, *j;* the vibratory palatal is the common *r*. The Gutturals likewise show the same list of varieties. First *k*, the mute; then the vocal *g;* the nasal *ng*, a simple sound, though spelt in our language with two letters; the aspirate *ch* (Scotch and German), as in *loch*, together with its fainter form *h;* the vocal aspirate *gh*, unknown and almost unpronounceable by us; and the vibratory *ghr*, occurring as a burr in some people's utterance. This classification, for which we are indebted to Dr. Arnott, may be summed up in the following table:—

	Labials.	Palatals.	Gutturals.
Mute	*p*	*t*	*k*
Vocal	*b*	*d*	*g*
Nasal	*m*	*n*, *l*	*ng*
Aspirate	*f*	*th*, *s*, *sh*	*ch*, *h*
Vocal Aspirate . . .	*v*	*th*, *z*, *j*	*gh*
Vibratory	*prr*	*r*	*ghr*

34. *Mental Phenomena of Voice.*—The voice, being a moving or active organ, presents all the mental facts and phenomena belonging to the moving organs in general. Exercise gives birth in it to a mass of feeling of the muscular kind, pleasurable when within due limits, with sense of fatigue and need of repose.

The tension of the vocal organs is always accompanied with an action of the chest, and this action needs to be stronger than an ordinary expiration. When the cords are made vocal without any reinforcement of the chest, we have a groan, or a wail, according as the tension is small or great, the one being a deep tone, and the other acute. But such is the association between high notes and increased exertion of the lungs, that it is difficult to produce a wail with only the ordinary breathing force.

In appreciating the pleasure springing out of vocal exercise, or the sensibility of the larynx under exertion, we must allow for this action of the respiratory organs, and also for the sensation of the resulting sounds on the ear. There can be little doubt, however, that when both these are deducted from the effect, there still remains a very considerable source of pleasure, due solely to the play of the laryngeal muscles, and which renders the free employment of the voice an important item of bodily gratification.

35. Besides the feelings of pleasure or of pain diffused from the vocal apparatus, there is, as in all the other muscles, a distinctive sense of the degree of tension of each separate muscle, such as to indicate the varying positions of the tube and the vocal cords. We have one feeling for the absence of tension, another for a low degree, a third for a higher degree, and so on. The sound produced at each of those stages

comes to be associated with the corresponding muscular condition of the organ, and hence we get the power of imitating sounds, or of producing them at pleasure. The association between the sound in the ear and the vocal position, together with the movement producing it, enables the one to recall or reinstate the others.

THE INTELLECT.

WE now proceed to view the Intellect, or the thinking function of the mind. The various faculties known as Memory, Judgment, Abstraction, Reason, Imagination,—are modes or varieties of Intellect. Although we can hardly ever exert this portion of our mental system in separation from the other elements of mind—Feeling and Volition, yet scientific method requires it to be described apart.

The primary, or fundamental attributes of Thought, or Intelligence, have been already stated to be, Consciousness of *Difference*, Consciousness of *Agreement*, and *Retentiveness*. The exposition of the Intellect will consist in tracing out the workings of these several attributes; the previous book containing the enumeration of all that we at first have to discriminate, identify, and retain.

(1.) The first and most fundamental property is the Consciousness of Difference, or DISCRIMINATION. To be distinctively affected by two or more successive impressions is the most general fact of consciousness. We are never conscious at all without experiencing transition or change. (This has been called the Law of Relativity.) When the mental outburst is characterized mainly by pleasure or pain, we are said to be under a state of *feeling*. When the prominent circumstance is discrimination of the two distinct modes of the transition, we are occupied *intellectually*. There are many transitions that give little or no feeling in the sense of pleasure or pain, and that are attended to *as* transitions, in other words, as Differences. In states of enjoyment or suffering, we cannot be strictly devoid of the consciousness of difference; but we abstain from the exercise of the discriminating (and the identifying) function, and follow out the consequences of a state of feeling as such, these being to husband the pleasure and abate the pain, by voluntary actions.

In the foregoing detail of the Feelings of Movement and the Sensations, the properties of each, as regards Feeling, and as regards Intellect, have always been kept distinct. In some of the Senses, as the Organic Sensibility, feeling is nearly every thing. In Taste and Smell, both feeling and discrimination are fully manifested. In Touch, and still more in Hearing, and in Sight, there are states of pleasure and of pain, and also a great number of sensations that are indifferent in those respects, and whose character it is to call forth the sensibilities to difference and to agreement. These last are the proper Intellectual Sensations. Thus the degrees of roughness or smoothness, of hardness or softness in Touch, are nothing as feeling, and everything as knowledge. Heat may be in such amount as to give intense pleasure or pain; it may also be wanting in either respect, and may occupy the mind purely with the consciousness of degree. The sensations of sound, in the same way, may incline to feeling, as in the pleasure of Music, or to intellect as in articulation. Light, colours, and visible forms have, similarly, a double aspect.

The sense of Difference, or Discrimination, has therefore been unavoidably illustrated, almost to exhaustion, in the enumeration of the muscular feelings and the sensations. As a means of intellectual *reproduction*—which is a leading function of Intellect, commonly expressed by Memory—the property of Discrimination manifests itself in one form, called the associating principle of Contrast. As identical with the law of the Relativity of all feeling and knowledge, it must emerge at a great many points, and be everywhere tacitly implied.

Some notice will have to be taken of *acquired* discrimination, but this is one of the applications of the Retentive power of the mind.

The conscious state arising from Agreement in the midst of difference is the natural complement of the foregoing attribute; the two together exhaust the primitive forms of intellectual susceptibility. But in the order of exposition, we shall give precedence to the property of Retentiveness, inasmuch as Agreement in its higher applications presupposes the whole range of our acquired knowledge, which depends upon the Retentive function.

(2.) The fundamental property of Intellect, named RETENTIVENESS, has two aspects, or degrees.

First. The persistence or continuance of mental impressions, after the withdrawal of the external agent. When the ear is struck by a sonorous wave, we have a sensation of sound, but the mental excitement does not die away because the sound ceases; there is a certain continuing effect, generally much feebler, but varying greatly according to circumstances, and on some occasions quite equal to the effect of the actual sensation. In consequence of this property, our mental excitement, due to external causes, may greatly outlast the causes themselves; we are enabled to go on living a life in ideas, in addition to the life in actualities.

But this is not all. We have, secondly, the power of recovering, or reviving, under the form of ideas, past or extinct sensations* and feeling of all kinds, without the originals, and by mental agencies alone.

* Although we can hardly avoid using such terms as 'recover,' 'revive, 'reproduce,' 'recollect,' with reference to Sensations, it is to be borne in mind that there is a radical difference between the Sensation and the recollection of the Sensation, or what is properly termed the Idea. This fundamental and unerasible difference relates to the sense of *objective reality* which belongs to the sensation, and not to the idea. The sensation caused by the sight of the sun is one thing, and the idea or recollection of the sun is another thing; for although the two resemble each other, they yet differ in this vital particular. For certain purposes (as, for example, in urging the will to pursuit or to avoidance) the idea can stand in the room of the sensation; the recollection of things answers the same ends as the real presence. But there is one great question connected with our science, in which this distinction is the turning point of the problem, namely, the question as to our perception and belief of an external world. In discussing that subject, we shall have to attend closely to the circumstances that characterize a sensation as distinct from the counterpart idea.

After the impression of a sound has ceased entirely, and the mind has been occupied with other things, there is a possibility of recovering from temporary oblivion the idea, or mental effect, without reproducing the actual sound. We remember, or bring back to mind, sights, and sounds, and thoughts, that have not been experienced for months or years. This implies a still higher mode of retentiveness than the previous fact; it supposes that something has been engrained in the mental structure; that an effect has been produced of a kind that succeeding impressions have not been able to blot out. Now, one medium of the restoration to consciousness of a particular past state, is the actual presence of some impression that had often occurred *in company* with that state. Thus we are reminded of a *name*—as ship, star, tree—by seeing the *thing;* the previous concurrence of name and thing has led to a mental companionship between the two. Impressions that have frequently accompanied one another in the mind grow together, so as to become at last almost inseparable: we cannot have one without a disposition or prompting to renew all the rest. This is the highest form of the Retentive, or plastic, property of the mind. It will be exemplified at length under the title of *Association* by *Contiguity.*

(3.) The remaining property of Intellect is consciousness of Agreement. Besides the consciousness of difference, the mind is also affected by agreement rising out of partial difference. The continuance of the same impression produces no effect, but after experiencing a certain impression and passing away from it to something else, the recurrence of the first causes a certain shock or start,—the shock of recognition; which is all the greater according as the circumstances of the present and of the past occurrence are different. Change produces one effect, the effect called discrimination; Similarity in the midst of change produces a new and distinct effect; and these are the two modes of intellectual stimulation, the two constituents of knowledge. When we see in the child the features of the man, we are struck by agreement in the midst of difference.

This power of recognition, identification, or discovery of likeness in unlikeness, is another means of bringing to mind past ideas; and is spoken of as the *Associating*, or *Reproductive* principle of SIMILARITY. We are as often reminded of things by their *resemblance* to something present, as by their previous *proximity* to what is now in the view. Contiguity and Similarity express two great principles or forces of mental *reproduction;* they are distinct powers of the mind, varying in degree among individuals—the one sometimes preponderating, and sometimes the other. The first governs Acquisition, the second Invention.

The commonly recognized intellectual faculties, enumerated by Psychologists with much discrepancy, in so far as they do not involve Feeling and Volition, are resolvable into these three primitive properties of Intellect—Discrimination, Retention, Similarity. The faculty called Memory is almost exclusively founded in the Retentive power, although sometimes aided by Similarity. The processes of Reason and Abstraction involve Similarity chiefly; there being in both the identification of resembling things. What is termed Judgment may consist in Discrimination on the one hand, or in the Sense of Agreement on the other: we determine two or more things either to differ or to agree. It is impossible to find any case of Judging that does not, in the last resort, mean one or other of these two essential activities of the intellect. Lastly, Imagination is a product of all the three fundamentals of our intelligence, with the addition of an element of Emotion.

The exposition of Intellect proper will consist mainly in a full development of the two processes of Retentiveness and Agreement. These will constitute the two first chapters. A third chapter will be devoted to the cases of Complicated mental Reproduction, including the association by Contrast. A fourth will deal with the applications of the intellectual forces to form new constructions—the Creative or Inventive faculty of the mind.

The purposes to be served by a scientific discussion of our intellectual powers are these:—

1. The explanation of the Laws that regulate the stream and Succession of our Thoughts is calculated to gratify our curiosity, or the natural desire of knowing the causes of things. Every person alive to the pleasures of knowledge is led, by this prompting, to inquire into the laws that simplify the great complications of the world. And there is no department where this desire is more likely to arise than in the ever present workings of the mind itself.

2. The theory of the intellectual powers affords a means of representing and explaining the differences of Intellectual Character in human beings. Such differences must refer to one or other of the fundamental attributes of our intelligence, and be susceptible of classification accordingly.

3. The art of Education must be grounded upon an accurate knowledge of the attribute of Retentiveness. We should endeavour to find out the circumstances that favour, and those that thwart, the process of mental acquisition.

What Locke termed the 'Conduct of the Understanding,' meaning the economical and effective employment of all our intellectual forces, includes education, and some things besides. It implies the methods of directing and aiding us in the higher operations, as Reasoning and Invention. The presumption is that a knowledge of the tools that we work with, may occasionally assist us in using them to the best advantage.

4. There are certain questions of vital interest, whose solution turns on ascertaining what parts of our intelligence are *primitive* and what *acquired*. Such are the Perception of a Material World and the Origin of our ideas of Space, Time, and Cause.

5. The theory of what constitutes Knowledge, what are the limits of human knowledge, and what is the nature of legitimate Explanation, must needs grow out of the investigation of our intellectual powers. It was to ascertain exactly what man is competent to know, that Locke applied himself to the enquiries that are the subject of his Essay, the publication of which was an epoch in the science of mind.

CHAPTER I.

RETENTIVENESS—LAW OF CONTIGUITY.

1. THIS principle is the basis of Memory, Habit, and the Acquired Powers in general. Writers on Mental Science have described it under various names. Sir William Hamilton terms it the law of 'Redintegration,' regarding it as the principle whereby one part of a whole brings up the other parts, as when the first words of a quotation recall the remainder, or one house in a street suggests the succeeding ones. The associating links called Order in Time, Order in Place, and Cause and Effect, are all included under it. We might also name it the law of Association proper, of Adhesion, Mental Adhesiveness, or Acquisition.

The following is a general statement of this mode of mental reproduction.

> Actions, Sensations, and States of Feeling, occurring together or in close succession, tend to grow together, or cohere, in such a way that, when any one of them is afterwards presented to the mind, the others are apt to be brought up in idea.

There are various circumstances or conditions that regulate and modify the operation of this principle, so as to render the adhesive growth more or less rapid and secure. These will be best brought out by degrees in the course of the exposition. As a general rule, Repetition is necessary in order to render coherent in the mind a train or aggregate of images, as, for example, the successive aspects of a panorama, with a sufficient degree of force to make one suggest the others at an after period. The precise degree of repetition needed depends on a variety of causes, the quality of the individual mind being one.

MOVEMENTS.

2. I shall commence the detailed exposition of the Law of Contiguity with the case of Muscular Activity, including under this head all kinds of movements, attitudes, and efforts of resistance.

Through the intellectual property of adhesiveness or plasticity, as expressed by this principle of contiguous association, movements can be linked together in trains, and made to succeed each other, with the same certainty and invariable sequence as we find in the instinctive successions of rhythmical action, already discussed. The complicated evolutions of a dance come to flow of their own accord, no less than the movements on all fours of the newly-dropped lamb.

We may begin with remarking the operation of the adhesive principle upon the Spontaneous and Instinctive actions themselves. These actions are plainly confirmed and invigorated by repetition. Although many creatures can walk as soon as they are born, they walk much better after a little practice. Here, however, we cannot easily make allowance for the growth of the parts themselves, apart from the effect of exercise. The muscles of the limbs increase in size, and the nerve-centres that stimulate and sustain the rhythmical movements acquire more development, through time alone. By practice, that is, by repetition, the infant sucks with more ease and vigour. In learning to walk, exercise undoubtedly concurs with the primitive alternating tendency of the limbs. The muscles of the body are strengthened by growth ; this growth is accelerated, if they are regularly exercised within limits ; and the very same is likely to be true of the nerves and nerve-centres that dictate the flow and alternation of muscular movements.

I have endeavoured to establish, as a fact, the spontaneous commencement of all the actions that we term voluntary. The limbs, the features, the eyes, the voice, the tongue, the jaw, the head, the trunk, &c., begin to move in consequence of an unprompted flow of stimulus from the nerve-centres; this flow will be sometimes to one set of members, and sometimes to another, so that the organs may act separately and independently under the influence thus imparted. Now, such spontaneous movements are without doubt confirmed by repetition, and are thereby made to recur more readily in the future. Any movement struck out by central energy leaves, as it were, a track behind; a less amount of nervous impulse will be required for its renewal. By a spontaneous stimulus the hands are closed; the act of closing determines a current or bent in that direction, and the next exertion is so much the easier. By one prompting, the arms are raised and lowered alternately; by another, they are moved forwards and backwards; in the course of a few repetitions, adhesiveness comes in aid of the inward stimulus, and the movements grow more frequent and more decided. Through the spontaneous action of the centres, the eyes are moved to and fro, and iteration gives facility to the exercise. So the voice is moved variously by an impulse from within, and each movement and note is made easier for the next occasion when the centres discharge their energy by that channel. The tongue is an organ with many movements, and all voluntary; these commence of their own accord, and are strengthened and, as it were, developed by repetition. The inclinations and sweep of the head, and of the trunk generally, are of the same class. The iteration of all these various movements does not make them voluntary movements, in the proper sense of the expression; but it prepares them for becoming such by a future and distinct acquisition. It makes them recur more frequently and more readily, enhancing the spontaneous impulse of the centres. On some one occasion, the voice sounds a high note. As to the first stimulus of the vocal energy, we can say nothing farther than that, with all the active organs, there is associated a nervous battery for commencing their movements. After an interval, the same high note is struck by a like discharge from the proper centre.

When several repetitions have occurred in this way, a facility is gained; either a less tension of the centre will originate the note, or it will be better sustained when it comes. Thus it is that a variety of detached movements are getting themselves prepared for subsequent use.

To persons that have not reflected on the very great difficulty and labour attending the growth of voluntary movements in infancy, this hypothesis of spontaneity so much dwelt upon, will seem uncalled for and unlikely. But I shall have to show, at a later stage, how impossible it is, without a supposition of this kind, to account for the commencement of the will.

3. We pass next to the acquisition of Aggregates and Trains of Movements as exemplified in mechanical operations generally. I assume the case of an individual already able to command the limbs, or other parts, as directed by another person, or by an example set for imitation.

The simplest instance is the joining of a movement to one already established. Take the case of walking, and suppose that we desire to communicate a peculiar set of the limb, for example, the turning out of the toes. A voluntary act, directed to the muscle that rotates the thigh outward, gives the requisite position to the foot; and the act is sustained while the walking movement goes on. By this means, there grows up in course of time an adhesion between the tension of the rotator muscles and the several movements of walking; and at length they coalesce in one complex whole, as if they had been united in the original mechanism of the system. So the power of performing the diagonal step in military exercises is acquired by combining, with the ordinary walking impulse, a lateral movement determined originally by an express volition. In first learning to walk, the preserving of the balance demands a combination of trunk movements with the forward movements of the limbs.

The acquiring of articulate Speech extensively involves the same agglutination. Every letter stands in need of an adjustment of tongue, jaws, and lips, difficult at first, but at last so easy that we do not know that we are performing a complicated act.

Take next a train or succession of movements. The sequence of acts in eating is one of our earliest acquirements. The lifting of the morsel by the spoon or fork, the carrying of it to the mouth, the opening of the mouth at the right moment, the action of the jaws and tongue,—all exhibit a succession of regulated acts fixed into mechanical coherence and certainty, by the mere fact that they have been made to succeed each other a great number of times. The action of carrying the hand to the mouth is followed by the opening of the jaws, as surely as the two alternate acts concerned in breathing give birth to each other.

In most mechanical successions, the feeling of the effect produced at each stage is a link in the transition to the next. Thus, in writing, the sight of the part last formed is the preamble to what comes next, as much so as the motion executed; in which case, the sequence is not one of pure motions—one motion bringing on the next in the habitual order. This mixture of sensations and motions in complex trains will form a separate head; I am desirous, at the present stage, to select a few examples of actual or pure movements linked together, without any other element being present. As, however, the guidance by the feeling is necessary in the course of *learning* any mechanical effort, the fixing of movements in a train, independently of such guidance, is the *last stage*, or highest perfection of mechanical acquirement. Thus, when one is playing on a pianoforte, and attending to something else at the same time, the sequence may be said to consist of pure movements: that is to say, each stroke is associated with another definite stroke or touch, through the whole succession of the piece. Yet, even in this case, it is difficult to say how much there is of a kind of latent sensation in the fingers and the ear, acting along with the association of pure movements.

A deaf person speaking must depend almost entirely on the associated sequence of movements; the only other assistance is the muscular feelings themselves, which always count for something. In saying over, to one's self, words committed by rote, the sequence of articulate motions is perfect. One word uttered brings on the next, independently of either hearing or the consciousness of articulation. This is a proof of the very great aptitude for associated movement belonging to the vocal organs; hardly any other part of the body, not even the hands, can acquire such perfection of unconscious dexterity. In knitting, there is probably the same sequence of movements, acquired after thousands of repetitions. The simpler figures of dancing can be gone through, with this mechanical and unconscious certainty, after a great amount of practice; but the docility of the lower limbs is far inferior to the hands, while these are second to the voice.

The difficulty of forming a perfect association of mere movements, and the dependence of most of the mechanical trains upon the sense of the effect produced, are curiously illustrated in paralyzed sensibility. Thus, there is an often-quoted case of a woman that could not hold a baby in her arms except by keeping her eyes fixed upon it. She had no sense of weight in her arms, and the sustained tension of the muscles was not sufficiently associated with the taking up of the child, by the muscular link alone. The sight of the eye was able to supply the want of arm sensibility, but both could not be dispensed with.

A more familiar example of the same fact is the signing of one's name—an operation that, by repetition, has been brought up to the highest pitch of automatic or mechanical sequence; and yet, when we make our signature without seeing it, the execution is very faulty.

It is the linking together of movements, so perfectly as to make them succeed one another without consciousness, that brings the acquisitions into comparison with the instincts. Such actions are sometimes called secondary-automatic.

Although very few of the cases of mechanical acquirement in general can belong to the class we are now considering, there are important distinctions of human character, founded on the facility of acquiring trains of movement, so as to uphold them with the least possible help from the guiding sensations and ideas. The trains of action so acquired cost the smallest amount of mental fatigue in the performance; they may, moreover, go on while the mind is employed upon other things.

4. In regard to the conditions that regulate the pace of our various acquisitions, some are general, others are special to individual kinds.

The general conditions are these :—

I. A certain amount of Continuance, or Repetition of the matter to be learned, is requisite : and the greater the continuance, or the more frequent the repetition, the greater the progress of the learner. Deficiency in the other conditions has to be made up by a protracted iteration.

II. The Concentration of the mind is an important condition. This means physically that the forces of the nervous system are strongly engaged upon the particular act, which is possible only by keeping the attention from wandering to other things. It is well known that distraction of mind is a bar to acquirement.

There are various modes of attaining the desired concentration. It is a voluntary act, prompted by present and by future pleasures and pains.

The greatest of all motives to concentration is a present enjoyment of the work in hand. Any exercise possessing a special charm detains us by immediate attraction; everything else is neglected so long as the fascination lasts. This is the inherent power of the will in its immediate and most efficient manifestation—a present pleasure furthering a present action. It explains the great influence of what is called the Taste for a special pursuit. The taste or fascination for music, for science, for business,—keeps the mind of the learner exclusively bent upon the subject; and the pace of acquisition is proportionally rapid.

Next to present enjoyment, is associated or future enjoyment; as when we devote ourselves to something uninteresting or painful in itself, but calculated to bring future gratification. This is, generally speaking, a less urgent stimulation, as being the influence of pleasure existing only in idea. There may, however, be all degrees of intensity of the motive, according to the strength of the ideal representation of the pleasure to come. It is on this stimulation, that we go through the dry studies necessary to a lucrative profession or a favourite object of pursuit. The young are insufficiently actuated by prospective pleasure, owing to their inferior ideal hold of it; and are therefore not powerfully moved in this way.

A third form of concentration is when present pain is made use of to deter and withdraw the mind from causes of distraction, or matters having an intrinsically superior charm. This is the final resort in securing the attention of the volatile learner. It is an inferior motive, on the score of economy, but cannot be dispensed with in early training. By an artificial appliance, the subject is made *comparatively* the most attractive. So with the use of future pains; the same allowance being made for the difference in their character, as for pleasures existing only in prospect.

Mere Excitement, whether as pleasure or as pain, or as neither, is a power of intellectual concentration. An idea that excites us very much persists in the mind, even if painful; and the remembrance of it will be stamped in consequence. This influence will be specially noticed, a few pages hence.

It is not uncommon, in stating the general conditions of Retentiveness, or memory, to specify the *vividness* or *intensity* of an impression; thus, we readily remember such effects as an intense odour, a speech uttered with vehemence, a conflagration. This, however, resolves itself into the concentration of mental and nervous force, due to the emotional excitement. Apart from the feelings, an idea may be more or less distinct and clear, but is not properly more or less intense. If an inscription is legible with ease, it is everything that the intellect demands; the adventitious aid of glaring characters, as when, at a public illumination, a sentiment is written in gas jets, is a species of excitement, securing an inordinate amount of attention or concentration of mind.

If we compare an object sharply defined with another whose lineaments are faded and obscure, there is a wide difference in the hold that the two would severally take on the memory; but such impressions differ in kind, and not simply in degree. The names 'vivid' and 'intense' are scarcely applicable except by a figure. Without a decisive difference or contrast, the mind is not impressed at all; everything that favours the contrast favours discrimination, and also depth of impression. All this, however, is pre-supposed as a fact or property of the *Discriminating* function of intellect; and is not to be repeated as appertaining to the *Retentive* function.

III. There appears to be *specific to each individual* a certain degree of General Retentiveness, or a certain aptitude for acquirement generally. We find a great inequality in the progress of learners placed almost exactly in the same circumstances. Sometimes the difference refers only to single departments, as mechanical art, music, or language; it is then referable to special and local endowments, as muscular sensibility, the musical ear, and so forth. Often, however, the superiority of individuals is seen in acquirement as a whole, in which form it is better regarded as a General power of Retentiveness.

5. We shall advert, as we proceed, to the modifying circumstances of a local kind peculiar to each class of acquisitions. As respects the present class, Movements, the special conditions seem to be as follows :—

(1.) Bodily Strength, or mere muscular vigour, must be regarded as favouring acquisition. Not only is it an indication of a large share of vitality in the muscles, which is likely to attend their acquired aptitudes; it also qualifies for enduring, without fatigue, a great amount of continuance or practice of the operations required.

(2.) Distinct from mere muscular power is Spontaneity, or the active temperament; meaning the natural proneness to copious muscular activity. This must be regarded as a property, not of the muscular tissue, but of the nerve-centres on the active side of the brain. Hence there is a likelihood, if not a certainty, that the endowment is accompanied with a greater facility in the association of movements. Observation accords with the view. It is usually men of abounding natural activity that make adroit mechanics, good sportsmen, and able combatants.

(3.) Of still greater importance is Muscular Delicacy, or Discrimination, which is not necessarily involved in either of the foregoing heads, although more allied to the second. The power of discriminating nice shades of muscular movement is at the foundation of muscular expertness in every mode. We have abundant proof that, wherever delicacy of discrimination exists, there exists also a special retentiveness of that class of impressions. The physical groundwork of the property is the abundance of the nerve elements—fibres and corpuscles—out of which also must spring the capacity for varied groupings and fixed associations.

Physical vigour in general, and those modes of it that are the counterparts of mental vigour in particular, must be reckoned among the conditions of Retentiveness. Other things being the same, acquisition is most rapid in health, and in the nourished and fresh condition of all the organs. When the forces of the system run strongly to the nervous system in general, there is a natural exuberance of all the mental manifestations; and energy of mind is then compatible with much bodily feebleness, yet not with any circumstances that restrict the nourishment of the brain.

IDEAL FEELINGS OF MOVEMENT.

6. The continuance and revival of feelings of movement without movement itself—that is, *ideal* feelings as opposed to the feelings accompanying actual movement—are a new and distinct case of the associating principle; a case, too, of great interest, as introducing us into the sphere of Thought.

This transition from the external to the internal, from the Reality to the Idea—the greatest leap that can be taken within the compass of our subject—needs, in accordance with the principle of our whole Exposition, to be prefaced by a consideration of the question, What is the probable seat, or local embodiment, of a sensation, or a mechanical feeling, when persisting after the fact, or when revived without the reality? The discussion of this question will interrupt, for a few pages, the exemplification of the law of Contiguous adhesiveness.

7. All the Muscular feelings can be sustained for some time after the physical cause has ceased. All the Sensations of the senses can be sustained in like manner, some more and some less easily; and they can afterwards be revived as ideas by means of the associating forces. What, then, is the mode of existence of those feelings bereft of their outward support and first cause? In what particular form do they possess or occupy the mental and cerebral system? This question admits of two different answers or assumptions, the one old and widely prevalent, the other new but better founded. The old notion supposes that the brain is a sort of receptacle of the impressions of sense, where they lie stored up in a chamber quite apart from the recipient apparatus, to be manifested again to the mind when the occasion calls. But the modern theory of the brain, already developed (see Introduction), suggests a totally different view. We have seen that the brain is only one part of the course of nervous action; that the completed circles take in the nerves and the extremities of the body; that nervous action supposes currents passing through these completed circles, or to and fro between the central ganglia and the organs of sense and motion; and that, short of a completed course, no nervous action exists. The idea of a cerebral closet shut-off is quite incompatible with the real manner of the working of nerve. Since, then, a sensation, in the first instance, diffuses nerve currents through the interior of the brain outwards to the organs of expression and movement,—the persistence of that sensation, after the outward exciting cause is withdrawn, can

be but a continuance of the same diffusive currents, perhaps less intense, but not otherwise different. The shock remaining in the ear and in the brain, after the sound of thunder, must pass through the same circles, and operate in the same way, as during the actual sound. We can have no reason for believing that, in this self-sustaining condition, the impression changes its seat, or passes into some new circles that have the special property of retaining it. Every part actuated *after* the shock must have been actuated *by* the shock, only more powerfully. With this single difference of intensity, the mode of existence of a sensation persisting after the fact is essentially the same as its mode of existence during the fact; the same organs are occupied, the same current action goes on. We see in the continuance of the attitude and expression the identical outward appearances, and these appearances are produced by the course of power being still by the same routes. Moreover, the identity in the mode of consciousness implies that the manner of action within the brain is unaltered.

8. Now, if this be the case with impressions *persisting* when the cause has ceased, what view are we to adopt concerning impressions *reproduced* by mental causes alone, or without the aid of the original, as in ordinary recollection? What is the manner of occupation of the brain with a resuscitated feeling of resistance, a smell, or a sound? There is only one answer that seems admissible. *The renewed feeling occupies the very same parts, and in the same manner, as the original feeling, and no other parts, nor in any other assignable manner.* I imagine that if our present knowledge of the brain had been present to the earliest speculators, this is the only hypothesis that would have occurred to them. For where should a past feeling be re-embodied, if not in the same organs as the feeling when present? It is only in this way that its identity can be preserved; a feeling differently embodied would be a different feeling.

It is possible, however, to adduce facts that set in a still clearer light this re-occupation of the sentient circles with recovered impressions and feelings. Take first the memory of feelings of energetic action, as when reviving the exploits or exertions of yesterday. It is a notorious circumstance that, if there be much excitement attending the recollection of these, we can only with great difficulty prevent ourselves from getting up to repeat them. The rush of feeling has gone on the old tracks, and seizes the same muscles; and would go the length of actually stimulating them to a repetition. A child cannot describe anything that it was engaged in, without acting it out to the full length that the circumstances will permit. A dog dreaming sets his feet a-going, and sometimes barks. The suppression of the full stage of perfect resuscitation needs an express effort of volition, and we are often even incapable of the effort. If the recollection were carried on in a separate chamber of the brain, it would not press in this way upon the bodily organs engaged in the actual transaction. The fact can only be, that the train of feeling is re-instated on the same parts as first vibrated to the original stimulus, and that our recollection is merely a repetition that does not usually go quite the same length, or stops short of actual execution. No better example could be furnished than the vocal recollections. When we recall the impression of a word or a sentence, if we do not speak it out, we feel the twitter of the organs just about to come to that point. The articulating parts,—the larynx, the tongue, the lips,—are all sensibly excited; a *suppressed articulation* is in fact the material of our recollection, the intellectual manifestation, the *idea* of speech. Some persons of weak or incontinent nerves can hardly think without muttering—they talk to themselves. The excitement of the parts may be very slight; it may not go the length of perceptibly affecting the muscles, but in the brain and communicating nerves it still passes the same rounds, however enfeebled in degree. The purposes of intellect can be served, even after this extreme enfeeblement of the currents, but their nature and their seat have not changed. They have not abandoned the walks of living articulation because they no longer speak out fully; they have not taken refuge in new chambers of the brain. We feel at any moment how easy it is to convert the ideas into utterances; it is only like making a whisper audible,—the mere addition of mechanical power. The tendency of the idea of an action to produce the fact, shows that the idea is already the fact in a weaker form. Thinking is restrained speaking or acting. If the disposition to yawning exists, the idea, anywise brought up, will excite the action. The suppressive effort usually accompanying ideas of action, which renders them ideas and not movements, is too feeble in this case, and the idea is therefore a repetition to the full of the reality.

9. Although at present engaged in preparing the way for the association of muscular feelings, yet the doctrine in hand being general for all states of mind, I must add some parallel instances from passive Sensation. Müller has furnished several in point. He says:—'The mere idea of a nauseous taste can excite the sensation even to the production of vomiting. The quality of the sensation is the property of the sensitive nerve, which is here excited without any external agent. The mere sight of a person about to pass a sharp instrument over glass or porcelain is sufficient, as Darwin remarks, to excite the well-known sensation in the teeth. The mere thinking of objects capable, when present, of exciting shuddering, is sufficient to produce that sensation of the surface in persons of irritable habits. The special properties of the higher senses, sight and hearing, are rarely thus excited in the waking state, but very frequently in sleep and dreams; for, that the images of dreams are really seen (under opium, images are actually seen), and not merely present in the imagination, any one may satisfy himself in his own person, by accustoming himself regularly to open his eyes when waking after a dream. The images seen in the dream are then sometimes still visible, and can be observed to disappear gradually. This was remarked by Spinoza, and I have convinced myself of it in my own person.'—p. 945. As another striking example, we may adduce the fact that the sight of food

brings about the flow of saliva in a hungry animal. The physiologist obtains saliva for experimental purposes, by presenting a savoury morsel to the view of a dog.

These and other cases that might be quoted, clearly confirm what has been said, as to the return of the nervous currents exactly on their own tracks, in revived sensation. We see that when the revival is energetic, it goes the length of exciting even the surface of sense itself by a sort of back-movement. We might think of a blow on the hand, until the skin were actually irritated and inflamed. The attention very much directed to any part of the body, as the great toe, for instance, is apt to produce a distinct feeling in the part, which we account for only by supposing a revived nerve-current to flow there, making a sort of false sensation, an influence from within mimicking the influences from without in sensation proper.—(See the writings of Mr. Braid, of Manchester, on Hypnotism, &c.)

10. The emotions and passions distinct from, but often accompanying sensations, are likewise similarly manifested in the reality and in the idea. Anger takes exactly the same course in the system whether with a person present, or with some one remembered or imagined. Nobody ever supposes in this case that the ideal passion is in any way different from the actual, or has any other course or seat in the brain. So with affection, egotism, fear, or any other sentiment or passion. In like manner, the remembrance of being angry, or puffed up, or terrified, will be a resuscitation of the identical state, and will actuate the same part, although the centrifugal wave may not be strong enough to agitate the surface as strongly as the original did. The recollection of the intenser feelings is necessarily weaker than the reality; of some of the less agitating sensations and feelings manifested in action, the recollection may be quite equal to the reality. We can better afford the expenditure necessary for reviving mild and gentle emotions.

11. The tendency of an idea to become the reality is a distinct source of active impulses in the mind. Our chief

active faculty is expressed by Will, or Volition, whose nature it is to urge us *from* pain or *to* pleasure. But the disposition to proceed from a mere recollection, imagination, or idea, to the action that it represents,—not merely to think an act, but to do it,—is also a determining principle of human conduct, and often sets itself in opposition to the regular action of the will, as above defined. For the most part, the tendency is kept in check; in ordinary circumstances, indeed, it does not manifest itself with any great energy, so that we may omit it from our reckoning of a man's motives. There are, however, circumstances that bring it forward as a considerable, and even preponderating, influence in individual conduct. The extreme illustration is seen under the mesmeric sleep, which has this curious effect, among others, that the patient is open to the reception of ideas suggested by another person, while the senses and the mind are unsusceptible to the external situation generally, and are to that extent asleep or unconscious. The wakefulness to our actual environment at each moment is necessarily the foremost circumstance in regulating our actions; the influence of our ideas is usually subordinated to the influence of present realities. In sleep, the mind is dead to reality, and more or less awake to the current of ideas; and in somnambulism and mesmeric sleep, and to a less extent in ordinary dreams, we act our ideas out to the full, the usual restraining power being dormant.

In waking moments, the general rule is that ideas do not act themselves out; their urgency is so small as to be in complete subjection to the will, operating under its ordinary motives. But there are times, when an idea possesses the mind so forcibly as to act itself out in opposition to the will, and therefore in opposition to those interests that the will should side with—the deliverance from pain and the furtherance of pleasure. This forcible possession is commonly the consequence of *great excitement* accompanying an idea, or its taking a more than usual hold of the mind, whereby it does not pass away with the intellectual currents, but remains and predominates over every other thought pressing for admittance.

12. The domination of an idea is best seen in the workings of Fear. When any object causes fright, the idea of that object is stamped on the mind with an intensity corresponding to the degree of the fright. The actions of the individual are in conformity to this idea, and not to his proper volitions. A mother is in a state of panic regarding a supposed danger to her child; she is no longer capable of acting for the best; the one exaggerated idea governs her whole conduct. The force that moves her is not volition; it resides in the circles of mere intellect, inflamed into undue excitement on one idea. The healthy and regular action of the will, aiming at the suppression of pain and the procuring of pleasure, would work for subduing the state of panic, so as to leave the mind in a cool and collected condition, able to estimate the danger at its exact amount, and with reference to all other interests. But the passion of fear is too much for the will. The idea rules the situation like a despot.

The principle is also illustrated by the predominance of purely painful ideas, even although not causing fright. The mere fact that an idea is disagreeable would suggest to the will to banish it, and we often succeed in banishing the thought of an object that pains us; but sometimes the intensity of the pain is such as to stamp it on the mind, and we cannot help acting it out, even to our own discomfort. Disgusts often exercise this unbidden ascendancy.

The fascination of a precipice is a familiar and pertinent example of the same tendency. The idea of a falling body is so intensely suggested, that an effort of volition is necessary to keep the spectator from acting it out in his own person.

It is often remarked that a painful recollection will haunt a person through life. This is an undue susceptibility to the influence of an idea, a morbid submission of the intellect to the will. Insanity is the culmination of this peculiarity. The insane are very generally the victims of a diseased impression. Occasionally this may give them pleasure, as when the idea takes the form of exorbitant vanity; more often, however, the idea is morbid and gloomy, and still controls the actions.

13. The only way that I am able to explain the great fact of our nature, denominated Sympathy, fellow-feeling, pity, compassion, disinterestedness, is by a reference to this tendency of an idea to act itself out. We are able to conceive the pains of other beings, by our experience of the like; and when we do so conceive them, we feel urged to the same steps of alleviation as if the pains were our own. We become possessed with the mere idea of pain, there being no reality corresponding; but yet this idea will induce us to act as if it represented a reality of our own experience. To see another person hungry and cold is to take on the idea of those painful states, and we are induced by the power of the idea to relieve the pain that occasioned it. But for some such domination of an idea, I see nothing in the constitution of the human mind that would make us sympathize with other men's pleasures and pains. The ordinary action of the will is to gain our own pleasures, and remove our own pains. This is all that can, strictly speaking, interest us. Each organization is more or less formed to work for conserving itself; and it would seem, at first sight, an irrelevance to go beyond this. The mere operation of the will, as we have always supposed it, is strictly within the limits of self-conservation. But the intellect, which can form ideas of the mental condition of other sensitive beings, tends to make those ideas actualities; or induces the conduct that they would suggest if the pains or pleasures were personal to ourselves. This is sympathy and disinterested action, which is an undoubted fact of our nature, although unequally manifested in different individuals.

14. Much of the ambition and the aspirations of human beings belongs rather to the sphere of fixed ideas, than to the sphere of volition prompted by pleasures. It is true that the things that we aspire after, are usually calculated to give us pleasure; yet very often we indulge in ideal aspirations that

are impracticable, and that, if we were masters of ourselves, we would disregard and repress. Unfortunately, however, a certain notion, say of power, wealth, grandeur, has fixed itself in our mind and keeps a persistent hold there, perverting the regular operation of the will, which would lead us to renounce whatever is hopeless or not worth the cost. Such phrases as 'insane ambition,' 'fixed idea,' 'overwhelming fascination,' are used to designate this not unfrequent phenomenon.

Our regrets for what we have lost are generally out of proportion to the pleasure that the objects gave us. We may feel a sincere and a strong regret for the loss of some one related to us, who was an unmitigated burden and misery. The consideration of our pleasures and pains solely would cause this to be felt as a relief and a gratification; but we cannot so banish a familiar idea even although painful; we cannot forget, merely because our happiness would be increased by forgetting. Thoughts persist by a law that is not subject to the will, and not only persist, but interfere with the course of our actions and the pursuit of our interests.*

15. The general doctrine now contended for is not a barren speculation; if true, it bears important practical inferences. In expressing and describing thought and the thinking process, an operation essential to our subject, the

* Correctly speaking, two forces are at work in determining the influence of fixed ideas. One is the tendency of the idea of an action to become the action, to which the exposition in the text is devoted. This tendency is exemplified in its unmixed operation in such instances as the infection of particular crimes, and in the operation of sympathy generally.

The other principle is the tendency of an idea to persist in the mind, in consequence of its intensity, or rather the intensity of the feeling that accompanies it. The power of the will is baffled by great mental excitement under any circumstances. It may be for our interest to banish a particular idea, and to give a footing to other ideas, which our intellectual forces are quite competent to suggest; yet when a feeling of any sort, whether pleasure or pain, or excitement that is neither, has allied itself with an idea, the forces of intellectual association and the force of the will are equally impotent to displace that idea. This is the way that fear operates to prevent a man from following out the regard to his own well-being.

doctrine is of great service: it helps us in some measure to localize these processes, and the language that might otherwise be deemed figurative becomes literal. The imagination of visible objects is a process of seeing; the musician's imagination is hearing; the phantasies of the cook and the gourmand tickle the palate.

The identity between actual and revived feelings shortens our labour by enabling us to transfer much of our knowledge of the one to the other. The properties that we find to hold of sensation in the actual, we may after a certain allowance ascribe to the ideal. Thus the qualities of the sense of sight in any one person, as for example, its discriminating power, would belong likewise to the visual ideas. The senses are in this way a key to the intellect.

16. I return to the Association of Feelings of Movement. It generally happens that if we can perform a movement actually, we can also perform it mentally. Thus we can go through in the mind the different steps of a dance; in other words, the feelings of the successive evolutions have been associated together, as well as the movements themselves. It must not be supposed, however, that the adhesion of actual movements and the adhesion of mental movements run exactly parallel, and that if the one is perfect so is the other. We may sometimes see a mechanic able to go through the actual steps of a process, but unable to go through them in his mind; the proof being that in describing them to another party he often forgets a step, and only remembers it by doing the thing. In this case the actions are more adhesive than the traces of them. It is not easy to produce any instance to show, on the other hand, that a series of actions can be repeated mentally and yet not bodily; for, as the mental actions are performed in the same circles, it usually needs only a volition, often the removal of a restraint merely, to bring them to the full length of actuating the muscles.

17. The principal field of examples of the association of pure feelings of muscular action, is the Voice. Most other cases are so complicated with sensation, that they do not

answer our present purpose. In speech, we have a series of actions fixed in trains by association, and performable either actually or mentally at pleasure; the mental action being nothing else than a sort of whisper, or approach to a whisper, instead of the full-spoken utterance. The child can repeat its catechism in a suppressed voice, as well as aloud. We can even acquire language mentally, or without speaking it out at all; that is to say, we can bring about a pure mental adhesion. To a learner, this happens continually: for in reading a book one does not speak the words vocally; the articulate adherence takes place from the first within the circles of ideation. Children, learning their lessons in school, must acquire the verbal successions in the same way.

As a general rule, it is best to rehearse verbal exercises aloud, if they are to be performed aloud, just as in the case of other mechanical operations. The sense of hearing is thus brought in aid of the other associating links. Besides, by coming to the actual execution, we set on a current that is both more energetic and larger in its sweep, inasmuch as it takes in the full operation of the muscles. In the early school acquirements, where everything has to be spoken out to the master, the audible repetition is the best; in after days, when we go over a great deal of language merely as thought, or the silent links of action, the speaking out is not called for; it would be an unnecessary waste of time and muscular exertion.*

18. The circumstances that favour the cohesion of mental trains of movement, are nearly the same as those already detailed for actual movements. A certain repetition is requisite; more or less, according as the other circumstances are favourable, namely, the *general* conditions of Concentration and Retentiveness on the whole; and the *special* muscular

* In the processes of meditation and thought, we are constantly forming new combinations, and these we can permanently retain, if we have dwelt upon them sufficiently long. A speaker meditating an address trusts to the adhesiveness of his verbal trains, although they have been all the while in the state of mere ideas, he not having spoken them aloud.

conditions—Muscular Strength, Spontaneity, and Discrimination.

We may perhaps assume a common character for the active organs in the same individual; an activity of temperament that shows itself in every kind of exertion—in limbs, voice, eyes, and every part that is moved by muscle—or a sluggish feebleness extending alike over every kind of exercise. But this does not exclude specific differences of endowment in separate members, rendering the movements more adhesive in one than in the others. Thus we may have a special development of the articulating members,—the voice, tongue, and mouth,—through superiority in the corresponding centres.

SENSATIONS OF THE SAME SENSE.

19. The next class of associable elements is the Sensations. We shall consider, first, the adhesion of impressions of the same sense—*homogeneous* impressions, as touches with touches, sounds with sounds, &c. There are various interesting operations that fall under this head; it comprises much of the early education of the senses.

In the inferior senses, there is little scope for exemplifying the process. In the Organic Feelings, we might note the expectation of a series of painful feelings from the occurrence of some one, as in an illness.

Even in Tastes, it is not common to have any important associations of one with another. One might easily suppose the formation of a train of tastes, such that any one would suggest the others, but instances are rare.

So with Smell. If we frequently experience a succession of smells in one fixed order, an adhesion will be formed between the different impressions; and, in consequence, when one is presented, all the rest will be ready to arise in succession, without the actual experience. In passing frequently through a garden along the same track, we might come to acquire a succession of odours, and from any one anticipate the next, as dogs probably do.

We seldom exist in a train of recollections of either Taste or Smell. They are difficult to realize to the full; and what we recover chiefly about them is their collaterals, such as the sentiment of liking or aversion that they produced. By a great effort of mind, we may approach very near the recovery of a smell that we have been extremely familiar with, as the odour of coffee; and if we were more dependent on ideas of smell, we might perhaps succeed still better; nevertheless, it must be admitted, that the recoverability of these states by mere mental association is of a low order.

20. This leads us to remark on the effect of repetition *in making any single impression adherent.* The separate taste of sugar, by repetition, impresses the mind more and more, and by this circumstance becomes gradually easier to retain in idea. The smell of a rose, after a thousand repetitions, comes much nearer to an independent ideal persistence, than after twenty repetitions. So it is with all the senses, high and low. Apart altogether from the association of two or more distinct sensations in a group, or in a train, there is a fixing process going on with every individual sensation, rendering it more easy to retain when the original has passed away, and more vivid when, by means of association, it is afterwards reproduced in idea. This is one great part of the education of the senses. The simplest impression that can be made, of Taste, Smell, Touch, Hearing, Sight, needs repetition in order to endure of its own accord; even in the most persistent sense, Sight, the impressions on the infant mind that do not stir a strong feeling, will be apt to vanish as soon as the eye is turned some other way. We might devote a separate illustration to this primitive phase of our retentiveness, but I am not aware of any important applications of it, where there is not also a process of association between a plurality of sensations. Yet it is proper to remark, that the confirming of the separate impressions of sense, by which they are prepared for existing in the idea, is going on all the time that these links of coherence are in course of formation.

21. We pass to the more intellectual senses, Touch, Hearing, and Sight.

In Touch, there are various classes of Sensations; the more purely emotional, as soft contacts and pungent contacts, and those entering into intellectual perceptions—as temperature, roughness, hardness, weight, size, &c. In all these, there is room for the associating principle to operate, but our present illustration will keep in view chiefly the second of the two classes, or those concerned in the development of the Intellect.

The sensation of any one surface, with all its peculiarities, is a complex thing; it is an aggregate of impressions made on the skin, and having a certain arrangement and intensity. The face of a brush yields a number of impressions all occurring together; these must take on a certain coherence, so that the sensation in its entireness may survive the actual contact. They must preserve their co-existence, and return *en masse* at an after time. In comparing one surface with another, as in choosing a tooth brush, it is necessary only that a complex impression of one should survive a few seconds, while the other is felt; in comparing one with some other long since worn out, the permanence behoves to be much greater. So with surfaces of cloth or wood, of stone or metals, judged of by their asperity; an associating process must fuse the multiplex impression before it can endure when the original is gone. Some surfaces are distinguished by an aggregate of asperity and temperature, as the cold touch of a stone or a lump of metal, in which case the feeling of cold must cohere along with the other parts of the tactual impression.

When muscular feelings and exertions are superadded to the impressions made on the skin, we obtain the complex notions of touch,—such as combine feelings of weight, size, shape, and situation, with texture or surface. Here an adhesion needs to take place between the tactile and mobile impressions. In order that a workman may recognize his tool by the hand alone, he must have had frequent experience of the complex feeling that characterizes its contact—the tactile impression of cold or warm, rough or smooth—with the muscular impressions of weight, size, and shape, these last qualities being determined by the muscular exertion of the hand while grasping it. A sufficiency of repetition will so fuse all these together, that the tool can be identified the moment it is touched.

In plastic operations, or in dealing with soft viscid matters requiring a particular consistency, as dough, clay, mortar, &c., it is necessary to attain firm impressions of different qualities and degrees of consistency, so as to know when the proper point has been exactly reached. This demands the cohesion of a complex sensation of touch; in other words, a certain skin feeling of clamminess and roughness, with the muscular feeling of resistance, will have to cohere into one fixed whole that shall never waver, vary, or be obscured, by the concurrence of other differing impressions. The repetition needful for such practical discrimination as plastic operators require is usually very great, amounting to hundreds or thousands of contacts. Individuals differ in their facility of fixing standard contacts by adhesive association. This is a case where it is impossible to mistake specialities of natural character. Some cannot, in a whole life, acquire the nicety that others possess after a few months' experience. Muscular sensibility must combine with skin sensibility; and we may judge, from the nature of the case, which of the two is chiefly concerned. A delicate muscular sensibility will show itself in other combinations besides touch. Moreover, some of the feelings included under touch have scarcely anything to do with the skin, as, for example, weight, size, and shape; great delicacy of discrimination in these has a purely muscular origin; while in judging of the texture of a cloth or the smoothness of a piece of mahogany, the skin sensibility is the proper test, but even here not unaccompanied by free movement.

By touch, therefore, under the operation of the cohesive property, we acquire fixed notions corresponding to the impressions made upon us by the objects that we handle. We contract engrained ideas of all the articles that we are in the custom of using. Thus, a workman is familiarized with his tools; and every person comes to know the instruments and furniture of their dwellings. But in order to appreciate the acquisitions of touch in their highest form, we must refer to the experience of the blind, who have no other sensation of solid and extended bodies. The impressions of sight are so much more enduring and revivable than any others, that we hardly ever think of a visible body otherwise than as seen by the eye; a workman, desiderating a hammer, thinks of its visible appearance, and not of its contact to his hand, although he is quite able to judge of it by this last feature. But the blind must *think* of objects as *felt* things; the revived sensation in them is a projection on the hands, not on the eyes, and they alone are in a position to judge, what is the natural permanence of skin impressions, and how far they can be recovered and lived in, when the reality is absent. Their thoughts, reveries, and dreams are touches, not sights. Not only is their power of tactile discrimination of a very exalted kind, but they also attain the higher state of realizing past touches as if fully present; that is, supposing such realization of touch to be, under any circumstances, fully attainable.

We must refer to the blind also for the association of trains, sequences, or succession of touches, made so coherent that any one may recall the entire chain. A blind man feeling his way along a wall by the hand, experiences in succession the different contacts; and these, by repetition, are so fixed in his mind, that, when he is placed at any one point, he anticipates all that is to follow. Being under the necessity of always guiding his course by touch, he acquires coherent successions of feelings of contact, as other men acquire of sights. He knows his whereabouts in a room by touch; the progress of his work, if he is engaged in handicraft operations, is measured tactually.

22. In acquiring associations of Sounds, we have to

encounter the supplanting tendency of the voice in the most interesting instances, namely, Articulate and Musical sounds. For while intently listening to a speech, we are liable to follow the speaker with a suppressed articulation of our own, whereby we take the train of words into a vocal embrace, as well as receive it passively on the sense of hearing. This is an instance of concurring or compound association.

As already observed in the other senses, the ear, by repetition, is formed to individual sounds, so as to retain them with ease after the cessation of the cause.

The simplest sound is so far a complex impression that it needs a plastic operation to fix its parts together. Thus an articulate syllable, *ma, ba,* is a really complex effect, occasioning a plurality of nervous currents: and to make all these flow together in company and order demands a certain length of repetition. We have already illustrated this under the agglutination of movements. The next stage is the coherence of trains or successions of sound, of which there are abundant examples. A simple air of music is a good illustration. Here a number of sounds follow one another in a fixed order; and by frequently hearing them, we learn to pass from the one to the other by ideal anticipation. When a sufficient number of notes have been struck to determine the air, the musician can proceed with all the rest. His education is made up of many hundreds of these sequences built up by degrees, under the plastic power of the mind.

The specific determining circumstance in musical acquisition is the quality of the ear, as shown by discrimination of pitch. That Discrimination is accompanied by Retentiveness, we assume on general grounds, there being no facts to the contrary; hence the one may be taken as a criterion of the other. As regards the application of the three general conditions of Retentiveness—Repetition, Concentration, and the Adhesiveness of the system on the whole—the first is the make-up for the deficiency in the rest. The circumstance of Concentration is principally manifested under natural liking, interest, or Taste; and taste follows, in a great measure, although not always in exact concomitance, the local endowment. Thus, a good musical ear, as tested by discrimination, would carry with it the taste, liking, or enjoyment of music, and thus be the best of all motives to mental concentration. The same line of remark is applicable to other acquisitions, and need not be repeated in every instance.

Articulate sounds are made coherent in like manner. The good articulate ear is, to some extent, a modification of the musical ear. In so far as the letters of the alphabet are distinguished by being combinations of musical tones, the two sensibilities must be the same. But, seeing that this is not wholly the case, we are not prepared to say that one may be always taken as evidence of the other.

A third quality of vocal sounds is cadence or accent, the basis of elocution, oratory, and rhythmical composition, and constituting the individual and national varieties of accent. The ear retains not merely successions of articulate sounds, but also the cadence of their pronunciation; and, when very susceptible to this class of effects, it shows itself in acquiring accent in mimicry, and in the elocution of the orator and the actor.

The associations in the ear are only one part of the acquisitions in Music, Speech, and Elocution; but they are no doubt the largest part.

23. Cohering trains and aggregates of the Sensations of Sight make, more than any other thing, perhaps more than all other things put together, the material of thought, memory, and imagination. That process of employing one sense as a substitute for others, principally avails itself of vision, the most retentive of them all. Thus it is, that objects thought of on account of their taste or smell, are actually *conceived* under their visual aspect. The image of a rose dwells in the mind as a visual picture, and, in a very inferior degree, as a perpetuated impression of a sweet odour.

Sensations of sight, as we have seen, are compounded of visual spectra and muscular feelings. A visible picture is, in fact, a train of rapid movements of the eyes, hither and thither, over luminous points, lines, and surfaces.

The education of the Eye goes through all the stages described for the other senses. There is, in the first place, an engrained impression of each separate Colour, the result of repetition, enabling their several ideas to endure in the absence of the original, and to persist of their own accord when once suggested.

The influence that gives the optical currents a facility in being induced and continued, so as to make one colour, as green, an object of comparison with other colours, is doubtless the same plastic power that forms aggregates of coloured expanse, connecting together a succession of tints, as a rainbow, or a sun-set. When we have passed repeatedly through the successive colours, the impression of one comes to induce the next, and that the following, and so on in order. But we can scarcely advance a step in this illustration without bringing in the movements of the eye, and the feelings belonging thereto. I can imagine an instance where the eyes, in a state of rest, have before them a number of colours produced in a fixed succession, flash after flash—red, orange, green, blue, violet, white, black, &c.—in which case a train of pure optical impressions would become fixed in the mind, and the occurrence of the first would tend to revive an image of the second, third, &c., on to the last. The gradations of daylight and darkness are associated in this way. But in the ordinary case of associated colours, they exist side by side, as in the colours of the landscape; and we move the eyes to see them, and thereby incorporate the act and feeling of Movement with the sensations of light. If the eye is in this way habituated to a train of colours, the habituation consists in this, that with each colour are associated both a movement of the eye and a second colour, and with this last movement and colour are connected a third movement and a new colour, and so on to the limit of the picture. If we suppose, for example, a chain of fields of different lengths and of varying tints; the eye first sweeps over a yellow corn field, then passes to a grass field of double the length, then to a plantation of wood still longer. The image of the first is an impression of yellow, accompanied with a definite sweep of the eye, and a corresponding continuance of the yellow impression; the image of the second is a green effect, doubly prolonged, or accompanied with a double sweep of the eye or the head, or both; the third image is a different tint of green, imbedded in a still wider muscular sweep. In these circumstances, and after due repetition, if the eye is impressed with the proper yellow hue along with the definite movement of the eye accompanying it, the image of the first field will be re-instated, and the mental movement set, as it were, in an old and accustomed groove; and there will be a transition from the optical impression of yellow and a given expanse, to the optical impression of a shade of green with an additional muscular sweep, and, lastly, to another shade of green with a still greater movement. These united impressions will be reinduced, one after another, as a consequence of contiguous growth.

Let us divide the detailed illustration into the two cases of Outline Forms and Coloured Surfaces. In order to exemplify the class of Outline Forms, we will suppose a white ring on a dark ground. Here we have a line of light and a round sweep of the eye concurring in one impression. The eye, following the ring, imbibes a continuous effect of light while performing a round movement; an optical and a muscular impression are conjoined, the muscular predominating; for the colour of the circumference is merely sufficient to give the lead to the ocular movement. The fixing of the image depends, almost exclusively, on the cohesion of movements of the muscles of the eye. Now, this case of the ring typifies a large class of important visual notions. The figures of geometry; the symbols or ciphers of Algebra, Chemistry, and the other symbolical sciences; the plans, diagrams, and outlines, used in the mechanical arts,—all depend for their retention, in the first instance, on the purely muscular endowments of the eye. Written language furnishes another class of visible forms; and in the Fine Arts of Sculpture and Architecture, form is the chief matter of the artist's consideration.

The circumstances that favour this acquisition are, as before, partly general and partly special. The general adhesiveness of the system being assumed, the special condition is retentiveness for Ocular Movements. According to the assumption formerly made, this will be found accompanying the special power of discrimination in those muscles, the consequence, no doubt, of a high development in the centres for regulating their movements.

Next to the general and the local retentiveness, we must advert to the mental Concentration, as due more especially to interest, taste, or liking, or a regard to the end to be served. We have noted three different classes of outline forms, all equally retainable, so far as the muscular retentiveness of the eye is concerned, but whose retention is stimulated by very different motives. These are Scientific forms, as the figures of Euclid; Arbitrary forms, as in written language; and Artistic forms. The attention to the first is prompted by whatever feelings constitute the scientific interest, or taste; the second class, the arbitrary forms of language, are aided by our interest in the ends of language, either for ordinary purposes, or for the studies of the scholar; the attention to the last is stimulated by the sensibility to Art. Looking at the peculiarities of these several cases, we can note that there is a greater concentration of mind upon the forms of Science and of Art, these being few and important, than upon the symbols of language, which are numerous and individually unimportant in the comparison. One would say that, in the case of language and arbitrary symbols, a high natural, disinterested, or unstimulated adhesiveness, would be requisite. A strong motive for concentrating the mind applies better to few things intensely held, than to a great multitude. The power of remembering a vast number of arbitrary visible marks may be set down as depending partly on a good general adhesiveness, and partly on the special muscular adhesiveness of the organ of vision. The acquiring of the Chinese language, with its many thousand characters, is perhaps the greatest example. The geographical memory for maps falls under the same head ; only, in this instance, there may be the prompting of a more powerful special interest.

24. We turn next to Coloured Surfaces, or those visual effects where light and shade, colour and lustre, prominently enter, as in a landscape, a spectacle, a picture, a room, a human face. Here the object consists of an aggregate of masses of colour, which are associated by whatever force of retentiveness or adhesion belongs to the impressions of colour. If we repeatedly gaze at a picture, its different patches of colour seize hold of the mind and connect themselves in their natural order, so that the one can recall the rest, and the whole can exist and be held in the view, when the actual object is no longer present. Masses of coloured decoration, the colours of rich calicoes, and the variegated dresses of an assembly of people, exemplify the situation where colour predominates over form, and where the retentiveness is much more Optical than Muscular. The impressibility to colour is put to the test by the attempt to recall objects like these. This attribute has no necessary connexion with the muscular susceptibility ; the two belong to independent organs, and follow different laws. Persons highly endowed as regards Colour have one of the gifts of a pictorial artist—painter or poet. The easy recollection or revival of scenes, and objects, and human faces, is necessary in order to work as a combiner in this class of things.

25. As in other cases, a superior hold of coloured surfaces rests upon general adhesiveness combined with local. A fine sense for shades of colour is a sufficient proof of a high local endowment, which will show itself in a corresponding power of retentiveness. There can be no reasonable doubt that the sense of colour is a primary sensibility of the mind ; and its consequences on the intellectual character are numerous and marked. It is not only identical with a facility of remembering scenes and pictures, and shades of colour ; it also generates a strong interest in the concrete, pictorial, and poetic aspects of the world, and a repulsion to the scientific point of view, which deals with

nature by means of abstractions and naked symbols. We are not to look for the scientific aptitudes in a mind highly sensitive to colour.

Besides, then, the positive conditions above enumerated of retentiveness to Form, we should add, as a negative condition, a moderate, or even inferior, susceptibility to Colour. The scientific man, the verbal scholar, and the artist in Forms are all the more powerful in their respective walks, that the impressibility of the eye to colour is reduced to a minimum. The ordinary limits of the human mind seem not to permit a high development in two such divergent lines of talent.

26. In the very early operations of the intellect, there is a subtle blending of all three functions—Discrimination, Agreement, and Retentiveness or Contiguous Association. The persistent hold of a distinct image of the simplest object, as a ring, has been attained through a complicated operation. There is a series of impressions of Difference, united with impressions of Agreement; while the total is fused together at last through the Retentive property.

27. It is also to be remarked that the cumulative operation of contiguity is interrupted by the absence of uniformity of conjunction in the things occurring together; out of which circumstance, arises a new class of mental phenomena. If only one species of ring were ever presented to the view, and if the specific colour were unknown except in that one object, there would be an inseparable contiguous association of that form and colour; neither could ever present itself without the other. But nearly every simple impression known to us exists in various connexions; a pure white colour, for example, is found in snow, in foam, in cloud, &c. Hence the effect of contiguity would be to bring up all these objects when a white colour is suggested; and sometimes we do, in fact, bring a host of individuals into view, by the suggestion of a common property. At other times, the mind, distracted by the number and variety of the connecting links, remains unmoved by any; or, from collateral influences in favour of some one, singles out that one to the neglect of the rest. (See Compound Association.)

It will hence be apparent that the occurrence of new conjunctions with a familiar property has a *dissociating* effect. Liquidity is at first associated with the other properties of water; when we become familiar with ice, this connexion is partially loosened. Certain properties at first exclusively allied with liquidity are now also allied with solidity, giving a second alternative; the additional experience of steam affording a third alternative. This is the situation described also under the name Abstraction or the Abstract Idea: by a fallacious tendency of the mind, the alternate connexion has been viewed as a possibility of separate existence; because 'white' has many alternative connexions, the supposition has been made, and received, that whiteness can exist out of all connexions.

28. It is farther to be noted, with reference to the process of acquisition, that the vast complicacy of the things to be acquired, of which the visible world is the most signal example, cannot be overtaken except by a system of *patching*, or employing the old to piece the new. Looking down from a height upon a large city with its rural environment, we form a coherent picture of the whole, which we can retain even in minute lineaments. This is possible only, because we have previously acquired coherent images of streets and spires, and fields and trees; and have connected them in aggregates not much differing from the present. We merely tack together our previous elements in a somewhat novel arrangement upon this new occasion; and the whole stress of the memory lies in consolidating the new grouping.

SENSATIONS OF DIFFERENT SENSES.

The concurrence of Sensations in one common stream of consciousness,—on the same cerebral highway,—enables those of different senses to be associated as readily as the sensations of the same sense. We will now therefore review the more remarkable instances that arise out of this heterogeneous concurrence. In so doing, it will be convenient to include also Movements actual and ideal.

29. *Movements with Sensations.*—It was previously remarked (p. 331) that there are few perfect associations of mere movement; the sense of the effect contributing most of the cohesiveness of a train of actions. There is, therefore,

the union of a movement with a sensation at each stage of the performance of a complicated operation. Even the simple case of walking requires that the expected contact of the foot with solid ground should concur with the motor stimulus of associated movements.

Under the same head, we may place the association of Actions with sensible Signs; as in all that department of lingual acquisition wherein names have the meaning of command, direction, guidance, control. Every movement that we make is connected with a certain form of words or a particular signal, which may set it on at any time. The child learns to connect vocal sounds with its various actions, and so becomes amenable to command and direction; and the education is continued all through life. The signs for indicating action may be various; the notes of the bugle, the signals at sea, the directions posted up on the walls, have all this acquired power of commanding movements. The same association enters into the education of animals; the horse and the dog soon learn to connect specific actions with the language, tones, and looks of human beings. Long before children possess the power of utterance themselves, many of their actions are associated with the sounds of language as uttered by others.

30. *Muscular Ideas with Sensations.*—The enduring forms, impressions, or Ideas of Movement, are associated with Sensations; and the two things recall each other. In the three higher senses, we have seen that there is an association of these two elements; many tactile, audible, and visible sensations being a coalition of the two. Under Sight, we connect the visible appearances of objects with their weight, hardness, and tenacity,—qualities purely muscular in their perception. Having experience of the weight of a piece of stone of a certain appearance, we associate the appearance with the weight, the one suggesting the other; so with hardness or tenacity. In this way, we have an associated connexion between substances and their uses founded on these properties. We acquire a strong feeling of the difference between

timber and stone, and between stone and metal, and demand that each should be differently proportioned in all kinds of erections and mechanical operations. It has been remarked that our sense of Architectural proportions is founded on our experience of stone, and would require to be re-adjusted if iron were as universally employed. If the specific gravity of the rocky materials of the globe had been equal to lead, instead of being about two and half times water, our sense of the weight of every piece of stone would have been four times as great as at present, and we should consequently have exacted, for the satisfaction of the eye, far more massive proportions in every kind of stone work.*

The knowledge of the Distance and the Direction of Sounds (Hearing, § 13), is in reality an association between sounds and movements or muscular ideas. The properties themselves are, not audible, but locomotive properties, signified to the mind by sensations of sound.

31. *Sensations with Sensations.*—Under this head allusion might be made to all the combinations that would arise by taking each sense along with every other; organic sensations with tastes and smells, with touches, sounds, and sights; tastes with smells, &c.; smells with touches, and so on. But it will suffice to quote the associations among the three higher senses.

Touches are associated with Sounds, when a body struck tells by the ring how it would feel, as in discriminating stone, wood, glass, pottery, &c. This is a very abundant, and generally very secure, adhesion.

Touches are associated with Sights, in the great comprehensive case of connecting the tactile properties of things with their visible appearance, whereby the one can instantly bring to mind the other. We associate the tangible qualities

* That is, supposing there was no increased tenacity, or power to resist crushing. Iron buildings are less massive than stone, notwithstanding the greater density of the material; but in this case the greater strength of the substance comes into play, and the employment of hollow and slender forms takes off from the weight to be supported.

of roughness, smoothness, solidity, liquidity, viscidity, with the characteristic impressions they make on the eye, and we can at any time recall the touch by the sight, or the sight by the touch. We can distinguish metals, stones, wood, cloths, leaves, flowers, by both senses; and we form an association between the tactile and the visible impressions. Each person has a large amount of knowledge existing in the shape of associated touches and sights. We connect likewise the form, as revealed to the touch, with the visible forms, and thus make the one confirm the other. Our notion of Figure is in fact a coalition of different impressions, and this gives to it a more complete and perfect character. I shall speak of this again presently.

Sounds are associated with Sights in innumerable instances. We connect the visible appearances of bodies with the noise they make when struck, as a glass, a spoon, a book, a hat. We associate an instrument of music with the peculiar quality of its note; we connect animals with their vocal utterance. So with human beings; each person known to us having a distinctive voice. In acquiring languages, there are two cases of the association. Every visible object is connected with the sound of its name—sun, mountain, house, &c.; and in learning to read, the sounds are associated with the written and printed characters.

32. With regard to the present class of *heterogeneous* associations, it is to be supposed, that the *rapidity of the adhesion* will vary with the adhesive quality of each of the two senses entering into the combination. Thus, when sounds are connected with sights, the goodness of the ear and the retentiveness of the eye will both contribute to the adhesion. Whence, all associations with sight will come sooner to maturity than the connexions formed among the inferior sensations. This circumstance it is that puts sight forward as the representative sense. Things that are *seen* have a more glorious resurrection in the mind than any others; we choose to conceive the objects of nature as they appear to the eye, rather than as they affect the ear or the

touch. Of all the ways that an orange can strike the senses, the visible aspect is, by pre-eminence, its revived manifestation, its 'idea.'

OF EXTERNAL PERCEPTION—THE MATERIAL WORLD.

33. We have now at this point to consider the perception and the knowledge of the Material World, which come through the muscular feelings and the sensations, by their association with one another. The manner of attaining to this knowledge, its exact nature and the degree of certainty attaching to it, give rise to some of the greatest questions of metaphysical philosophy. Two problems especially call for notice at this stage. The first is the origin of the perceptions we owe to vision, namely, the Forms and Magnitudes of External Bodies, and their Distances from the eye. Ever since these perceptions were affirmed by Berkeley to be not original, but acquired, they have formed a subject of discussion with metaphysical writers. The second question relates to the Perception of an External and Material World; it grew out of the other, both historically and naturally, and was the prominent metaphysical question of the eighteenth century.

34. *Of the Perception of the Distances and the Magnitudes of External Bodies.*—The distinctive susceptibility of the eye is for Colour. This is the effect specific to it as a sense. But the feeling of Colour *by itself*, implies no knowledge of any outward object, as a cause or a thing wherein the colour inheres. It is simply a mental effect or influence, a feeling or conscious state, which we should be able to distinguish from other conscious states, as for example, a smell or a sound. We should also be able to mark the difference between it and others of the same kind, more or less vivid, more or less enduring, more or less voluminous. So we should distinguish the qualitative differences between one colour and another. Pleasure or pain, with discrimination of intensity and of duration, would attach to the mere sensation of colour.

Knowledge or belief in an external or material coloured body, there would be none.

But when we add the Active or Muscular sensibility of the eye, we obtain new products. The sweep of the eye over the coloured field gives a feeling of a definite amount of *action*, an exercise of internal power, which is something totally different from the passive feeling of light. This action has many various modes, all of the same quality, but all distinctively felt and recognized by us. Thus the movements may be in any direction—horizontal, vertical, or slanting; and every one of these movements is felt as different from every other. In addition to these, we have the movements of adjustment of the eye, in accordance with differences in the remoteness of objects. We have distinctive feelings belonging to these different adjustments, just as we have for the different movements across the field of view. If the eyes are adjusted first to clear vision for an object six inches from the eye, and afterwards change their adjustment to suit an object six feet distant, we are distinctly conscious of the change, and of the degree or amount of it; we know that the change is greater than in extending the adjustment to a three-feet distance, while it is less than we should have to go through for a twenty-feet distance. Thus in the alterations of the eyes for near and far, we have a distinctive consciousness of amount or degree, no less than in the movements for right and left, up and down. Feelings having the character of *activity* are thus incorporated with the sensibility to *colour;* the luminous impression is associated with exertion on our part, and is no longer a purely passive state. We find that the light changes as our activity changes; we recognize in it a certain connexion with our movements; an association springs up between the passive feeling and the active energies of the visual organ, and of the body generally; the changes of view involving movements of the head and trunk, as well as the sweep of the eye within its own orbit.

We have not yet attained to the perception or knowledge of any outward thing as the source of colour, or as the occasion of the varying movements and adjustments of the eyes. We have distinctive feelings of colour, the varying consciousness of active energies, and the association of the two in one fact, but nothing to reveal or suggest external things; we have merely the means of comparing a number of various mental states. Nor do I see how, with the eye *alone*, we can ever pass from the internal consciousness to the external perception—to the recognition, knowledge, and belief of things out of, or apart from, ourselves, the causes of those internal states. Many have contended for, and many more have assumed, this power as attaching to vision. But in so doing, they seem to have fallen into a confusion of idea respecting the mental nature of this perception of an outer world, as I shall now endeavour to explain.

35. It is admitted that the recognition of a world apart from self is mixed up with the perception of such qualities as Extension, Form, and Remoteness, called *Primary* qualities of matter. Heat, Odour, Taste, Colour, alone, do not suggest external and independent objects, being for this reason termed the *Secondary* qualities of bodies. Let us consider, therefore, the two facts of Distance and Extension, both which imply outward existence, in so far as we recognize and believe in the reality of a material world apart from the mind. With regard to these two qualities—namely, (1) the distance of a thing from the seeing eye, and (2) the real dimensions of a body in space—I affirm that they cannot be perceived or known through the medium of sight alone.

Take first the case of Distance, or remoteness. It appears to me that the very *meaning* of this quality—the full import of the fact implied in it—is such as cannot be taken in by mere sight. For what is meant by an object being four yards distant from where we stand? I imagine that, among other things, we understand this—namely, that it would take a certain number of paces to come up to it, or to reduce the distance from four yards, say to one yard. The possibility of a certain amount of locomotion is implied in the very idea of distance. The eye would be distinctly aware of a change, when the distance was reduced from four yards to one, but it has of itself no knowledge of the cause or accompanying incidents of that change. These are measured by our other activities, and, in the case of great distances, by the locomotive energy and continuance requisite to pass from the one to the other. In the case of objects within reach of the hand, the movements of the arm give the measure of distance; they supply the accompanying fact that makes distance something more than a mere visible impression. When we say, that a thing has been shifted from a position of six inches' distance from the eye to a position of twelve, we imply that, with the change of ocular effect, there has been another change corresponding to a certain definite movement of the hand and arm in a forward direction; and, unless by supposing this additional action, we have no key whatever to the alteration that has come over our visible image. I say, therefore, that distance cannot be perceived by the eye, because the idea of distance, by its very nature, implies feelings and measurements out of the eye, and located in the other active organs, —the locomotive and other moving members. If our notion of distance did not reveal to us the fact that by so many steps, or by a certain swing of the arm or bend of the body, we should make a definite change in the appearance of the object, it would not be a notion of distance; there might be an ocular effect, but not a revelation of distance. Granted that the eye is very distinctly affected by every change in the remoteness of a visible object from six inches to a mile, that it recognizes a variation of impression all through this interval, this would not answer the question, how far is the object removed at each step? I do not see, even, how it could tell which way the thing was moving. The actual distance means so many inches, feet, or yards, and of these we have no measure by the eye; indeed, they have no relevancy as regards the eye; they concern the locomotive and other mechanical movements, but not the movements of sight.

With the active exertion of the body in locomotion we have a definite muscular feeling; we recognize one exertion as greater or less than another; the feeling of a long stride is different from a short; six paces are attended by a different consciousness from four. We acquire permanent and revivable impressions of these exertions when any one has been often repeated, as, for example, pacing the length of a room. We can compare any new case with this old habitual effort, and there results a consciousness of more or less. This I take to be our starting point in the feeling of distance traversed, or of linear extension in general; this is the source of our perception, and the measure and standard of reference, when we arrive at the same notion by other means. When, along with a forward movement, we behold a steadily varying change of appearance in the objects before us, we associate the change with the locomotive effort, and after many repetitions we firmly connect the one with the other. We then know what fact accompanies (1) a certain muscular tension of the eye-ball, (2) a definite feeling of convergence of the two eyes, (3) a certain dissimilarity of the two pictures, (4) a given amount of clearness or haziness of prospect, and (5) a fixed or varying retinal magnitude; these ocular feelings (both optical and muscular) have been connected with the further and distinct experience of a definite locomotive energy to be expended to bring about a definite change in their amount or degree. Apart from this association, the eye-feelings might be contrasted or compared, or connected with other eye-feelings, but there would be no farther suggestion in the case. The collective feelings that we have when the ciliary muscle is relaxed, when the eyes are parallel (vision being distinct), when the two pictures are the same, when a slight haze covers the image, and when the retinal magnitude of familiar forms is small—all imply, as the result of foregone experience, that a prolonged effort of locomotion would be requisite to convert these feelings into their extreme opposites; this suggestion of locomotive effort is the fact, and the whole fact, named real Distance from the spectator.

Such, as translated into the language of our more advanced Psychology, is the Berkleian view of the perception of Distance; a view that long seemed, to the great mass of scientific men, to be irresistible; while very few became converts to Berkeley's doctrine of the Perception of a Material World, to which the theory of Vision was a prelude. But, in our own day, the explanation of Distance by *association* has been impugned; and the opposite, or *instinctive* theory reverted to.

Many even of the latest objections to the theory apply only to the imperfections in the author's mode of stating it. In his time, the muscular or active sensibility of the human system had no distinct place in the account of the senses; it was noticed only as a part of Touch. Berkeley's language, representing our perception of distance as an association of Sight and Touch, must be set down as wholly inaccurate and inadequate. But when we substitute for Touch the entire aggregate of our Movements, there is presented an entirely new front, to which the attack has not yet been fairly directed.

The strength of the case against any form of the theory lies principally in the great maturity of the perception of Distance at a very early period of life; which seems out of proportion to the usual pace of acquisition; while the means and opportunities of the needful experience are represented, by opponents, as altogether incommensurate to the result. These opportunities, however, are greatly understated. In particular, two leading circumstances are left out of the account.

In the first place, for the experience of Touch (in Berkeley's language), which in the infant must be very small from the immaturity of the organs, not to speak of their limited range—substitute the entire movements of the body, however arising. The locomotion in the arms of the nurse, is a part of the experience of changing distance. The infant must have a muscular sensibility in being carried from place to place, as well as in walking on its own limbs; whence its education in real distance begins from the first moment of life, and is kept in constant daily practice. If we suppose it carried from one spot to another, on an average twenty times in a day, it would have in the first year seven thousand lessons in distances on the large scale, besides the smaller experiments with its own arms and body as it acquires the self-moving aptitude.

The second fact overlooked is the remarkable delicacy of the appreciation of changes of *retinal magnitude;* which, for all changes of place, are great and conspicuous. This particular sensibility ranks, in point of acuteness and discrimination, the *first of all human sensibilities.* It is a combination of our two most sensitive organs—the retina and the ocular group of muscles. Whenever we desire to obtain a delicate measurement of any quality, we transform it into visible magnitude, as in the balance and the thermometer. Consider, then, that the infant, in being carried from one part of a room to another, experiences the most extraordinary expansion or contraction of its retinal images; an effect that must be soon stamped on its memory in association with the attendant experience, locomotive or other. In mature life, we are rarely conscious of these retinal changes, being accustomed regularly to translate the fluctuating appearances into some constant real magnitude; but we may easily judge of their efficiency by adverting to the remarkable suggestiveness of a vista. Now, until the effect of the incessant education in coupling locomotive movements with the impressive alterations of retinal magnitude (together with all the other ocular changes) is fully allowed for, we cannot say how far the early experience of infancy is insufficient to form the associations between Distance and its visible signs. The question has never been argued on this basis.

It would be easy to adduce many inconsistencies and fatal admissions on the part of the advocates of the instinctive theory; and all the difficulties attaching to innate ideas generally have to be encountered in this instance. If it be admitted that Distance is something beyond a purely ocular impression, there is the improbability of an innate alliance between two senses; we do not smell sounds, nor hear tastes. This improbability must be met by unequivocal facts.*

* It is stated by Mr. Abbot, that though the eye possesses the power of perceiving distance, it cannot possess any idea of the amount of walking necessary to pass over it ('Sight and Touch,' p. 134). Mr. Mill justly observes that this surrenders the whole question: 'if we saw distance, we should not need to learn by experience what distance we saw.' To which Mr. Abbot replies, 'He might just as well say that to admit that a person can be taught to distinguish musical tones with accuracy, is to admit that they are not perceived by the ear. If we heard the tunes we should not need to learn

36. If we next attend to the sweep of the eye over the field of view, as required by an object extended laterally, we shall find, in the same manner, that this sweep gives a most distinctive consciousness, so that a larger sweep can be discriminated from a smaller; but it gives no information besides. It tells of no outward thing, so far as I can make out; certainly it does not tell of extension, as Real Magnitude, for this simple reason, that extension means a given movement of body or limb. If I say that a log of wood I see before me is six yards long, I mean that it would take a certain number of my paces to traverse its length: the visual impression of itself cannot mean or imply any fact of this kind, until experience has connected the sweep of the eye with the sweep of the legs or other moveable parts.

Accordingly, I hold, as regards Extension in general, that this is a feeling derived in the first instance from the locomotive or moving organs; that a definite amount of movement of these comes to be associated with the sweep and adjustments and other effects of the eye; and that the notion when full grown is a compound of locomotion, touch, and vision, any one implying and recalling the others. A certain movement of the eye, as the sweep over a table, gives us the sense of that table's magnitude, when it recalls or revives the extent and direction of arm movement necessary to compass the length, breadth, and height of the table. Previous to

what tunes we heard. Certainly we are no less beholden to experience for the accurate knowledge of the distances we move through.' Mr. Abbot's parallel is not in point. The dispute is not as to the intrinsic sensibility of the eye, for colour, &c., the only thing analogous to the sensibility of the ear to the pitch of a sound; it respects an added or foreign experience; the true parallel would be our hearing distance (which also we do, by an *acquired process)*. It is admitted that we need no education to tell the ear that it hears pitch, or to tell the eye that it sees colour, but we do want experience to tell us of another property, discovered by another sensibility, that such property accompanies a sensation of sight or of sound.

The dispute is interminable and futile, so long as Distance is believed to mean something *exclusive of possible locomotion*. If distance is more than the intrinsic sensibility of the eye—to light, colour, visible movement and visible form—and yet less than our locomotive experience, what is it?

this experience, the sight of the table would be a mere visible effect, differing consciously from other visible effects, and not suggesting any foreign effect whatever. It could not suggest Magnitude, because magnitude is not magnitude, if it do not mean the extent of movement of the arms or limbs that would be needed to compass the object; and this can be gained in no way but through actual trial by these very organs.

37. The conclusion, therefore, is that Extension, Size, or Magnitude, owes, not only its origin, but its essential import, or meaning, to a combination of different effects associated together under the cohesive principle we are now considering. Extension, or space, as a quality, has *no other* origin and no other meaning than the association of these different sensitive and motor effects. The coalition of sensations of sight and of touch with felt motive energies, explains everything that belongs to our notion of extended magnitude or SPACE.

This view has both its supporters and its opponents. Of the opposition, I shall content myself with referring to Sir William Hamilton, who expresses himself on the subject in the following terms:—'The opinions so generally prevalent, that through touch, or touch and muscular feeling, or touch and sight, or touch, muscular feeling, and sight,—that through these senses exclusively, we are percipient of extension, &c., I do not admit. On the contrary, I hold that all sensations whatsoever, of which we are conscious, as one out of another, *eo ipso*, afford us the condition of immediately and necessarily apprehending extension; for in the consciousness itself of such reciprocal outness is actually involved a perception of difference of place in space, and, consequently, of the extended.'—*Dissertations on Reid*, p. 861.* The statement

* The circumstance that the eye contains within itself an active element, namely, its very numerous and acutely felt movements, renders vision something beyond optical sensation. Hamilton does not advert to this fact, and seems to maintain that, even excluding the consciousness of ocular movement, the eye can be the means of suggesting space. Now, so far is this from being proved, that a very strong case may be made to show that the optical sensibility does not give even *visible* form (to give which would be to step into the province of another part of the visual mechanism).

here made admits of two interpretations. The one is that the mere fact of optical distinctness and plurality carries with it as a part of its own nature the perception of space; a supposition entirely gratuitous. The second interpretation is that

In following a wide ranging movement, or, in expatiating over a large prospect, we must move the eyes, or the head; and probably every one would allow that, in such a case, feelings of movement make a part of our sensation and our subsequent idea. The visible notion of a mountain evidently contains feelings of visual movement. But when we look at a circle, say, one tenth of an inch in diameter, the eye can take in the whole of it without movement, and we might suppose that the sensation is, in that case, purely optical, there being no apparent necessity for introducing the muscular consciousness. A characteristic optical impression is produced; we should be able to discriminate between the small circle and a square, or an oval; or between it and a somewhat larger or a somewhat smaller circle, from the mere optical difference of the effect on the retina. Why then may we not say, that, through the luminous tracing alone, we have the feeling of visible form?

By making an extreme supposition of this nature, it is possible to remove the case from a direct experimental test. We may still, however, see very strong grounds for maintaining the presence of a muscular element even in this instance. In the first place, our notions of form are manifestly obtained by working on the large scale, or by the survey of objects of such magnitude as to demand the sweep of the eye, in order to comprehend them. We lay the foundations of our knowledge of visible outline in circumstances where the eye must be *active*, and must mix its own activity with the retinal feelings. The visual idea of a circle is first gained by moving the eye round some circular object of considerable size. Having done this, we transfer the fact of motion to smaller circles, although they would not of themselves demand an extensive ocular sweep. So that when we look at a little round body, we are already pre-occupied with the double nature of visible form, and are not in a position to say how we should regard it, if that were our first experience of a circle.

But, in the second place, as remarked in the text, with regard to Distance and Extension, the essential *import* of visible form is something not attainable without the experience of moving the eye. If we looked at a little round spot, we should know an optical difference between it and a triangular spot, and we should recognize it as identical with another round spot; but that is merely retinal knowledge, or optical discrimination. That would not be to recognize form, because by form we never mean so little as a mere change of colour. We mean by a round form something that would take a given sweep of the eye to comprehend it; and unless we identify the small spot with the circles previously seen, we do not perceive it to be a circle. It may remain in our mind as a purely optical meaning; but we can never cross the chasm that separates an optical meaning from an effect combining light and movement, in any other way than by bringing in some experience of movement.

the author tacitly implies the Kantian doctrine of space as an *à priori* form, manifested in consciousness when we have plurality of optical sensations, as two candle flames. Without dwelling on all the difficulties attendant on *à priori* forms, we are content here to present the alternative, or *à posteriori* explanation, which is that space involves, as its very import, locomotive experience, and is made up by a combination of sensations with feelings of movement, actual and possible. If I see two distinct objects before me, as two candle flames, I apprehend them as different objects, and as distant from one another by an interval of space; but this apprehension pre-supposes an independent experience and knowledge of lineal extension. There is no evidence to show that, at the first sight of these objects, and before any association is formed between visible appearances and other movements, I should be able to apprehend in the double appearance a difference of place. I feel a distinctness of impression, partly optical and partly muscular; but in order that this distinctness may mean to me a difference of position in space, it must reveal the additional fact, that a certain movement of my arm would carry my hand from the one flame to the other, or that some other movement of mine would change by a definite amount the appearance I now see. If no information is conveyed respecting the possibility of movements of the body generally, no idea of space is given, for we never consider that we have a notion of space, unless we distinctly recognize this possibility. But how a vision to the eye can reveal beforehand what would be the experience of the hand or the other moving members, has never been explained.

The conjoint experience of the senses and the movements appears to me to furnish all that we possess in the notion of Extended matter. The association between sight and locomotion, or between touch and the movements of the arm, tells us that a given appearance implies the possibility of a certain movement; that a remote building implies a certain continuance of our walking exertions to change its appearance into another that we call a near view: and the power of motion, the scope for moving, exhausts every property in the idea of empty space. We estimate it first by our own movements, and next by other movements measured in the first instance by our own, as for example, the flight of a bird, the speed of a cannon ball, or the movement of light. The mental conception that we have of empty Space, is *scope for movement,* the possibility or potentiality of moving; and this conception we derive from our experience of movements. The *resistance to movement* is our notion of a Plenum or occupied space; the *extent of movement* is our measure of the linear Extension of body or extended Magnitude. No internal revelation, nothing in the nature of intuition or innate suggestion, is required for giving us such notions as we actually have of these qualities.

Perception and Belief of the Material World.

38. Inasmuch as knowledge and perception are purely mental, it has been asked whether there be anything else than mind and its activities in the universe; or what reason have we for believing in the existence of counterpart objects apart from, and independent of, our sensations. May not waking thought be itself a dream? On this question, more generally interesting than perhaps any other in our subject, the following remarks are submitted.

(1.) There is no possible knowledge of a world except in reference to our minds. Knowledge means a state of mind; the notion of material things is a mental fact. We are incapable even of discussing the existence of an independent material world; the very act is a contradiction. We can speak only of a world presented to our own minds. By an illusion of language, we fancy that we are capable of contemplating a world that does not enter into our own mental existence; but the attempt belies itself, for this contemplation is an effort of mind.

Nevertheless, we are accustomed to divide the act of cognition, or knowledge, into two parts—a something knowing, and a something known. In Sensation, we seem to have the sentient mind, and the thing felt—*sentiens* and *sensum*. Some account must be rendered of this twofold nature of sense and knowledge. If the something that knows, feels, perceives, be called mind, what is the other something that is known, felt, perceived?

(2.) Solidity, Extension, and Space,—the foundation properties of the material world,—mean, as has been said above, certain movements and energies of our own body, and exist in our minds in the shape of feelings of Force allied with Visible, and Tactile, and other sensible impressions. The sense of the external is the consciousness of particular energies and activities of our own.

If we were the subjects of purely passive sensation,—such sensations as warmth, odour, light—apart from any movement of any active member whatever, our recognition of the external world would necessarily be something very different from what we now experience. The state of the consciousness would then, so far as we are able to imagine it, be of the nature of a dream, and our perception of the universe would be sufficiently represented by the common theory of idealism.

But in us, sensation is never wholly passive, and in general is much the reverse. Moreover, the tendency to movement exists before the stimulus of sensation; and movement gives a new character to our whole percipient existence. The putting forth of energy, and the consciousness of that energy, are facts totally different in their nature from pure sensation; meaning thereby sensation without activity, of which we can form some approximate idea, from the extreme instances occurring to us of impressions languidly received.

It is in this exercise of Force that we must look for the peculiar feeling of *externality* of objects, or the distinction that we make between what impresses us from without and impressions not recognized as *external*. Any impression on the senses that rouses muscular energy, and that varies with that energy, we call an *external* impression. Dr. Johnson refuted Berkeley, as he thought, by kicking a stone. In fact, this action of Johnson's illustrates the real nature of our recognition of externality. It was his own exertion with its consequences, and not the optical impression of a stone on the eye, that satisfied him as to the existence of something outside of him. The sum total of all the occasions for putting forth active energy, or for conceiving this as possible to be put forth, is our external world.

Taking the order of the senses followed in our exposition in the previous book, Touch is the first that decidedly makes us cognizant of an external world. But if we were confining ourselves to the class of sensations of soft touch, where we have the passive pleasure of the sense in highest perfection, we should not find much superiority in this sense over smell, on the point now under consideration. It is *hard contact* that suggests externality; and the reason is, that in this contact we must put forth force of our own. The more intense the pressure, the more energetic the activity called forth by it. This mixed state, produced through reacting upon a sensation of touch by a muscular exertion, constitutes the *sense of resistance,* the feeling that is the deepest foundation of our notion of externality. 'There is no feeling of our nature of more importance to us than that of resistance. Of all our sensations, it is the most unintermitted; for, whether we sit, or lie, or stand, or walk, still the feeling of resistance is present to us. Everything we touch at the same time resists; and everything we hear, see, taste, or smell, suggests the idea of something that resists. It is through the medium of resistance that every act, by which we subject to our use the objects and laws of nature, is performed. And of the complex states of consciousness, there is hardly one in which the feeling or idea of resistance is not included.'—(James Mill.) In fact, we constantly carry about with us the feeling or the notion of resisting, in other words, the state where a sensation of touch is coupled with the putting forth of effort or force.

The main consideration, therefore, in this great question is, that the totality of our mental life is made up of two kinds of consciousness—the Object consciousness and the Subject consciousness. The first is our external world, our *non-ego*; the second is our *ego*, or mind proper. It is quite true that the object consciousness, which we call Externality, is still a mode of self in the most comprehensive sense, but not in the usual restricted sense of 'self' and 'mind,' which are names for the subject, to the exclusion of the object.

(3.) We experience certain uniformly recurring sensations, and certain uniform changes in these, when we exert particular energies. Thus the visible picture of our dwelling is a permanent and habitual experience, and the variations undergone by it correspond principally to our own conscious movements. But at times the appearance is entirely withdrawn, and exists only in memory or idea. We then feel the difference between the two experiences, the *ideal* and the *actual*, and we assign some superiority in the mode of existence of the one over the other. The superiority we soon find to connect itself with the changes due to our movements; a mere picture or *idea* remains the same whatever be our bodily position or bodily exertions; the sensation that we call the *actual* is entirely at the mercy of our movements, shifting in every possible way according to the varieties of action that we go through. With a forward movement the visible impression enlarges; with a backward movement it diminishes. A movement of the eye shuts it off; another movement restores it. The carriage of the head alters it from side to side; the bending of the body varies it in other ways. We are constrained to make a distinction between the things that are thus shifted by all our movements, and the ideas or dreams that vary of themselves while we are still. Even if sensation meant nothing apart from ourselves, we should still have to distinguish between present sensation and remembered or revived sensation; the reference of the one to our voluntary movements, and of the other to no such modifying causes, would oblige us to note a vital difference in the two classes of facts. Such is the uniformity of connexion between certain appearances and certain movements, that we come to anticipate the one through the other. We know that in some one position, as when lying in bed, a movement of the limbs will bring us to the sensation of a solid contact in the feet; that another series of movements will bring on a particular view to the sight; that a third movement will bring the sound of a bell to the ear, and so forth. We recognize all those sensible effects, thus brought uniformly into play by a regular series of waking voluntary actions, as totally different from our ideas, recollections, and dreams.

(4.) As our belief in the externality of causes of our sensations means that certain actions of ours will bring the sensations into play, or modify them in a known manner, this belief is easily furnished to us by experience; it is no more than our experience entitles us to entertain. Having felt again and again that a tree becomes larger to the eye as we move; that this movement brings on at last a sensation of touch; that this sensation of touch varies with movements of our arm, and a great many other similar coincidences; the repetition of all this experience fixes it in the mind, and from the sight alone we can anticipate all the rest. We then know that our movements will bring about all the changes and sensations above described, and we know no more; but this knowledge is to us the recognition of external existence, the only thing, so far as I see, that external existence can possibly mean. Belief in external reality is the anticipation of a given effect to a given antecedent; and the effects and causes are our own various sensations and movements.

(5.) When we find that one fixed set of movements brings on at the same time *sensations of various senses,*—as when approaching an orchard we have sights and sounds and touches and smells and tastes,—the fact very much enhances the notion we have of the *dependence of sense on action or movement,* the richness, so to speak, of the external world, the value of our action as bringing on sensation. Moreover, when successive movements bring forward endless varieties of new sensations, we are in this way also impressed with the abundance of effect brought on as a consequence of our own movement. We see the largeness of the possible world as compared with the appearance that self makes,—the expanse of our own body,—which is to us a constant unit of comparison and standard of reference. Whether the causes of appearances are external to our mind or not, we are at all events certain that they are external to our bodies; for between the world and each one's corporeal presence a comparison is possible: while between the world and mind there is no comparison, the things not being homogeneous. We incur the absurdity of converting mind into a substance to be viewed by another mind, when we speak of our perceiving faculty as an extended thing. But a world extending beyond our own person we can understand; it implies that the movement that traverses the body must be many times multiplied to traverse the world, that is, to bring forward the whole array of possible changes of sensation.

(6.) When we come to communicate with other beings, and discover by the signs of communication that they pass through the same experience as ourselves, this enhances still more the constancy of the association between our sensations and the corresponding active energies. We ascertain that, at times when we ourselves are not affected by a particular sensation, as of light, other persons are affected by it. This leads us to generalize sensation still more, and to form to ourselves an *abstraction* that comprehends all our experience, past and present, and all the experience of others; which abstraction is the utmost that our minds can attain to respecting an external and material world. So often as I open my eyes I have the sensation of light (the exceptions are not material to the illustration). I thereupon associate this sensation with this action, and I expect in all future time that the action will lead to the sensation. Other persons tell me the same thing. I thereupon affirm as a general fact, that an optical feeling will always follow a certain muscular feeling, to me and to other sentient beings; and I can affirm nothing more, nor can I have any possible interest or concern with anything more. The assertion that light and the sun have a permanent and independent existence has, for its basis and for its import, that I and all other beings with whom I have had any communication, have had a certain optical feeling in conjunction with certain activities of which we have been conscious, and firmly anticipate the same coincidence in the future. The external existence of a stone wall means the association between certain optical impressions and a particular locomotive effort, and a further and still more decided association between touch and another effort, namely, what we call the sense of resistance. Finding the same sequence to exist with reference to beings in general, we generalize the fact to the very farthest limits, and affirm that it has always been so in the past, and will always be so in the future. Our language is apt to go beyond this; out of all the *particular* experiences (which alone constitute the real evidence for the proposition) we construct an experience in the *abstract*, a most anomalous fiction, that goes the length of affirming that the sensation is not only sure to occur along with the appropriate actions, but that it exists whether these actions take place or not. We seem to have no better way of assuring ourselves and all mankind that with the conscious movement of opening the eyes there will always be a consciousness of light, than by saying that the light exists as independent fact, with or without any eyes to see it. But if we consider the case fairly, we shall see that this assertion errs not simply in being beyond any evidence that we can have, but also in being a self-contradiction. We are affirming that to have an existence out of consciousness which we cannot know but as in consciousness. In words, we assert independent existence, while in the very act of doing so, we contradict ourselves. Even a possible world implies a possible mind to perceive it, just as much as an actual world implies an actual mind. The mistake of the common modes of expression in this matter, is the mistake of supposing the abstractions of the mind to have a separate and independent existence. This is the doctrine of the Platonic 'ideas,' or 'forms,' which are understood to impart all that is common to the particular facts or realities, instead of being derived from them by an operation of the mind. Thus the actual circles of nature derive their mathematical properties from the pre-existing 'idea,' or circle in the abstract; the actual men owe their sameness to the ideal man. So, instead of looking upon the doctrine of an external and independent world as a generalization or abstraction grounded on our particular experiences, summing up the past, and predicting the future, we have got into the way of maintaining the abstraction to be an independent reality, the foundation, or cause, or origin of all those experiences.

The distinction drawn between the *sentiens* and the *sensum* is, in fact, a distinction between the two contrasting modes of our conscious existence. In passive feeling, we are in one mode of existence; in putting forth active energy, we are in another mode. A sensation is, properly speaking, a *sensum*, a phase of our *objective* consciousness. When we say that to this *sensum* there must correspond, from the necessity of the case, a *sentiens*, our meaning is, that the same being, now all sensation, exists in another phase —the phase of passive feelings and ideas; that what is sensation at this moment may be idea in the next moment, and may concur in the same stream of consciousness with ideas and feelings. We live a double life, of object states and of subject states. The *sentiens*, or the mind that feels, is one portion of the totality of our being; the *sensum*, the thing felt, is the alternative or contrasting portion of our being, the attitude of putting forth actual energy. The validity of the contrast does not require that we should be both subject and object in the same instant; the principle of the essential Relativity of all knowledge, does not suppose that both elements of every contrasting couple should be always present. Enough that one is actually present, and that the other has been previously present (the more recently the better). We are rarely in a pure object-state; but, on many occasions, we are in a pure subject-state, being all passivity and ideas.

The amount of constant dependence of the *non-ego* upon the *ego*, the need there is for a *sentiens* to accompany each attitude of *sensum*, may be elucidated by attending to other subject and object relations, besides the great and cardinal relation between the Unextended Mind and the Extended and external World. I, the subject, may be at times an object; I may make my own mental states—my passive feelings, and my successions of thought—a matter of study and consideration, as in the investigations of mental science. Properly speaking, at that moment I am all subject; I have withdrawn myself so completely from the cognition of the object world, that no part of me is then an object in the chief acceptation of object—the *non-ego*, or the extended material world. But within the subject sphere, in which I exclusively am for the time, I might be said to be divided into two parts—the recollection of my feelings or states, which I am studying, and the act of studying them; the one, the fact studied, is, in a certain sense, an object; the other, the effort of studying, is the subject. So, when engrossed in remembering, I am all subject, since what I remember is some idea or ideas, and my act of remembering is also called a part of my *ego*, or self. These cases will show what there is of the *ego* in the *sentiens*, as something accompanying the *sensum*. The ego, in these instances, is a *voluntary effort or act;* and all such voluntary acts are prompted by some *feeling*—in the strict subjective sense, some pleasure or pain. Whenever we are acted on by a feeling, we are in a subject-state; and hence our external perceptions, or our sensations of the object world, have thus much of the subject usually going along with them, that they are moved by some truly subject-state. This is not an absolute, unvarying necessity; we may, by mere spontaneous activity, or habit, be cognizant of external things; there may be no volition in the proper form; and in the further absence of any ideas or passive feelings, or any special enjoyment of the pleasure of exercise, we should be all *sensum*, and no *sentiens*. If a *sentiens* were still to be affirmed as implied in the fact of a *sensum*, it would amount to no more than this, that the two inhere in the same being, which they divide between them, and are never long separated. For it must be farther conceded, that the absence of a true manifestation of the *sentiens* from an attitude of the *sensum* is rare and exceptional. Whenever perception as a voluntary act exists, subjectivity as feeling must be present to give the motive. And farther, whenever the sensation is felt as passing into the idea, that is, if we cease from the active effort of attention, and pass into the state of remembering what we have just perceived, we are relaxing our attitude of *sensum* in favour of a mode of *sentiens*.

It is this participation of the subject in every act of *will*, that enables us to make a minor subject-and-object distinction, when any part of our *ego* is studied by us; as when we remember, reason, or imagine—all which operations fall wholly within our subjectivity. Inasmuch as we are specially in a subject state when a motive to the will is present, our voluntary promptings are, in relation to our remembered feelings and ideas, a more determined subjectivity; and the remembered states themselves are the co-relative objects. Thus, while *sentiens* and *sensum*, or *percipiens* and *perceptum*, may be said to mark the great and vital distinction of subject and object,—Mind and the Extended; *cognoscens* and *cognitum* may express a subject and object distinction made within the subject, a distinction of far inferior importance, and of a transient nature, grounded on the more peculiarly subject character of the states that move the will, as compared with other states that have no present motive efficacy. There is the same element of pure subjectivity in *cognoscens* as in *sentiens*, and we so far apply the analogy, as to divide ourselves into two parts in both cases; but the division has a very different importance in the introspective cognition, compared with the *sensum* or *perceptum* of the Extended.

39. Having touched on the metaphysical disputes growing out of the questions as to the first origin and precise import of our notions of distance and extension, I must now advert to the exact process whereby we are made cognizant, by sight, of those properties that are out of the sphere of its immediate recognition. The relations between these four distinct facts, namely, Ocular Adjustment for seeing an object, the Extent of the image on the Retina, the Distance, and the true Magnitude of the object, are what we have to consider; for we find that, in the educated eye, these circumstances are suggestive of one another. On this subject I shall avail myself of the observations of Sir Charles Wheatstone, in his Bakerian Lecture, contained in the *Philosophical Transactions* for 1852. The question to be solved is, how do we come to connect a certain felt effect on the eye, with a knowledge of the distance and size of the object causing the impression; as when we

say that a lamp-post is twenty feet off, or that a distant wood is within three or four miles. When the gaze is still, the optical impression implies no more than these two facts,—a certain effect of light and colour, and an adjustment of the eyes singly and conjointly; when the gaze is wandering, the movements and changes of adjustment operate in addition.

'Under the ordinary conditions of vision, when an object is placed at a certain distance before the eyes, several concurring circumstances remain constant, and they always vary in the same order when the distance of the object is changed. Thus, as we approach the object, or as it is brought nearer to us, the magnitude of the picture on the retina increases; the inclination of the optic axes required to cause the pictures to fall on corresponding places of the retinæ, becomes greater; the divergence of the rays of light proceeding from each point of the object, and which determines the adaptation of the eyes to distinct vision of that point, increases; and the dissimilarity of the two pictures projected on the retinæ also becomes greater. It is important to ascertain in what manner our perception of the magnitude and distance of objects depends on these various circumstances, and to inquire which are the most, and which the least, influential in the judgments we form. To advance this inquiry beyond the point to which it has hitherto been brought, it is not sufficient to content ourselves with drawing conclusions from observations on the circumstances under which vision naturally occurs, as preceding writers on this subject mostly have done, but it is necessary to have more extended recourse to the methods so successfully employed in experimental philosophy, and to endeavour, wherever it be possible, not only to analyze the elements of vision, but also to re-combine them in unusual manners, so that they may be associated under circumstances that never naturally occur.'—p. 2.

Accordingly, Sir C. Wheatstone has devised an instrument, being a modification of his reflecting stereoscope, whereby he can expose pictures to the two eyes in such a manner that the Distance can be changed while the Convergence of the two eyes remains the same, or the Convergence be altered while the Distance remains the same, thus disassociating two effects that constantly go together in ordinary vision. The result of the experiments showed the influence of each of the two circumstances, namely, the Convergence of the eyes and the Size of the picture on the retina (which is greater as the object is nearer), in determining our judgment of Distance. He found that, the distance of the object remaining the same, the greater convergence of the two eyes makes the object seem smaller, this increased convergence being required in ordinary vision when a thing is brought nearer. It appears, therefore, that while the retinal magnitude is unaltered, greater convergence gives a perception of smaller Size. On the other hand, leaving the inclination of the axes unchanged, and bringing the pictures nearer, thereby increasing the picture on the retina, we have a perception of increased Size in the object. 'The perceived magnitude of an object, therefore, diminishes as the inclination of the axes becomes greater, while the distance remains the same; and it increases when the inclination of the axes remains the same, while the distance diminishes. When both these conditions vary inversely, as they do in ordinary vision when the distance of an object changes, the perceived magnitude remains the same.'

Thus, as regards the perception or appreciation of the *real magnitudes* of objects seen by the eye, the association lies between a certain magnitude (ascertained by other means than sight), and a certain inclination of the optic axes with a given size of the picture on the retina. The figure of a man, of which we have a certain muscular estimate by our movements and previous experience, when viewed at some one inclination of the optic axes, yields an image on the retina of a particular size; and with such inclination and size of image we then associate the muscular appreciation of an object six feet high, &c. The concurrence of these two conditions always suggest a similar magnitude or extent of the thing viewed. And if the optic inclination is made smaller, that is, if the axes of the eyes approach more to parallelism, while at the same time the image on the retina is correspondingly less, as by removing the object to a greater distance, there will still be a perception of the same size, or the same muscular appreciation will be suggested to the mind. We have an association of the size of a man with a great many different combinations of those two circumstances, produced by variation of actual distance.

40. And next, as respects our perception and estimate of *dis-*

tance, or the suggestion of a given locomotive exertion with a visual appearance. On this head, Sir C. Wheatstone's observations are somewhat different from the received views. He considers that the appreciation of distance, instead of preceding the estimate of magnitude, *follows* it. 'It is the prevalent opinion that the sensation which accompanies the inclination of the optic axes immediately suggests distance, and that the perceived magnitude of an object is a judgment arising from our consciousness of its distance, and of the magnitude of its picture on the retina. From the experiments I have brought forward, it rather appears to me that what the sensation which is connected with the convergences of the axes immediately suggests, is a correction of the retinal magnitude to make it agree with the real magnitude of the object, and that distance, instead of being a simple perception, is a judgment arising from a comparison of the retinal and perceived magnitudes. However this may be, unless other signs accompany the sensation of convergence, the notion of distance we thence derive is uncertain and obscure; whereas the perception of the change of magnitude it occasions is obvious and unmistakeable.' According to this view, *distance is more firmly associated with the retinal magnitude* than with the other circumstances of optical inclination. When we view an object receding, as a carriage, we are impressed with the change of distance more through the diminishing size of the picture it makes on the retina, than through the approach of the optic axes to parallelism. I am not at all surprised at this, seeing that the change in the size of the retinal picture is so much more evident and distinct, as a sensation, than the very slight corresponding alteration in the inclination of the axes. When we once ascertain the real magnitude of a body, the approach or receding of it is very easily measured from this change of the picture. Now, according to Sir. C. Wheatstone, *the inclination of the axes, in company with a given retinal picture, suggests the magnitude first, and from the true magnitude thus known, and the retinal magnitude, we infer the distance.** This, it may be remarked, is the strongest

* When a known object is magnified by a lens we suppose it brought nearer to us, owing to this increase of retinal magnitude while the convergence remains the same.

I have not specially adverted in the text to the signs of distance furpossible proof of our former thesis, that the perception of Distance is acquired.

41. Passing now to the perception of *solidity*, or solid effect, on which the discovery of the stereoscope has cast a new light, by connecting that effect with the action of the two eyes, I find that Sir C. Wheatstone, in his published paper,

nished by the colour and appearance of objects. This point has been well illustrated by Dr. Reid.—*Inquiry*, Chap. vi., Sect. 22. I quote the following paragraphs :—

'The colours of objects, according as they are more distant, become more faint and languid, and are tinged more with the azure of the intervening atmosphere; to this we may add, that their minute parts become more indistinct, and their outline less accurately defined. It is by these means chiefly, that painters can represent objects at very different distances, upon the same canvass. And the diminution of the magnitude of an object would not have the effect of making it appear to be at a great distance, without this degradation of colour and indistinctness of the outline and of the minute parts. If a painter should make a human figure ten times less than other human figures that are in the same piece, having the colours as bright and the outline and minute parts as accurately defined, it would not have the appearance of a man at a great distance, but of a pigmy or Lilliputian.

'When an object has a known variety of colours, its distance is more clearly indicated by the gradual dilution of the colours into one another, than when it is of one uniform colour. In the steeple which stands before me at a small distance, the joinings of the stones are clearly perceptible; the grey colour of the stone, and the white cement are distinctly limited; when I see it at a greater distance, the joinings of the stones are less distinct, and the colour of the stone and of the cement begin to dilute into one another: at a distance still greater, the joinings disappear altogether, and the variety of colour vanishes.

'In an apple tree which stands at the distance of about twelve feet, covered with flowers, I can perceive the figure and the colour of the leaves and petals, pieces of branches, some larger, others smaller, peeping through the intervals of the leaves—some of them enlightened by the sun's rays, others shaded; and some openings of the sky are perceived through the whole. When I gradually remove from this tree, the appearance, even as to colour, changes every minute. First, the smaller parts, then the larger, are gradually confounded and mixed. The colours of leaves, petals, branches, and sky are gradually diluted into each other, and the colour of the whole becomes more and more uniform. This change of appearance, corresponding to the several distances, marks the distance more exactly than if the whole object had been one of colour.

'Dr. Smith in his "Optics" gives us a very curious observation made by Bishop Berkeley in his travels through Italy and Sicily. He observed, that considers this as still imperfectly explained. I have reason to believe, however, that, having made many experiments with the view of elucidating the point, he inclines to the view that there is a *mental effect produced over and above the optical effect*, which mental effect overrides the optical impression, and gives a perception really different from the

in those countries, cities and palaces seen at a great distance appeared nearer to him by several miles than they really were; and he very judiciously imputed it to this cause: that the purity of the Italian and Sicilian air gave to very distant objects that degree of brightness and distinctness which, in the grosser air of his own country, was to be seen only in those that are near. The purity of the Italian air hath been assigned as the reason why the Italian painters commonly gave a more lively colour to the sky than the Flemish. Ought they not, for the same reason, to give less degradation to the colours, and less indistinctness of the minute parts, in the representation of very distant objects?

'It is very certain that, as, in air uncommonly pure, we are apt to think visible objects nearer and less than they really are, so, in air uncommonly foggy, we are apt to think them more distant and larger than the truth. Walking by the sea-side in a thick fog, I see an object which seems to me to be a man on horseback, and at the distance of about half a mile. My companion, who has better eyes, or is more accustomed to see such objects in such circumstances, assures me that it is a sea-gull, and not a man on horseback. Upon a second view, I immediately assent to his opinion, and now it appears to me to be a sea-gull, and at the distance only of seventy or eighty yards. The mistake made on this occasion, and the correction of it, are both so sudden, that we are at a loss whether to call them by the name of *judgment*, or by that of *simple perception*.

'It is not worth while to dispute about names, but it is evident that my belief, both first and last, was produced rather by signs than by arguments, and that the mind proceeded to the conclusions in both cases by habit, and not by ratiocination. And the process of the mind seems to have been this—First, not knowing, or not minding the effect of a foggy air on the visible appearance of objects, the object seems to me to have that degradation of colour, and that indistinctness of the outline, which objects have at the distance of half a mile; therefore, from the visible appearance as a sign, I immediately proceed to the belief that the object is half a mile distant. Then, this distance, together with the visible magnitude, signify to me the real magnitude, which, supposing the distance to be half a mile, must be equal to that of the man on horseback. Thus the deception is brought about. But when I am assured that it is a sea-gull, the real magnitude of a sea-gull, together with the magnitude presented to the eye, immediately suggest the distance, which in this case, cannot be above seventy or eighty yards; the indistinctness of the figure likewise suggests the fogginess of the air as its literal sensation. The sense of solidity, arising from the conjoined action of two dissimilar views of an object presented to the two eyes, means a suggestion to the mind that one part of the object is farther off than another, as estimated by our locomotive organs; in other words, the impression revives in us an idea of movement to or from the eye in company

cause; and now the whole chain of signs, and things signified, seems stronger and better connected than it was before; the half mile vanishes to eighty yards; the man on horseback dwindles to a sea-gull; I get a new perception, and wonder how I got the former, or what is become of it, for it is now so entirely gone, that I cannot recover it.

'It ought to be observed that, in order to produce such deceptions from the clearness or fogginess of the air, it must be uncommonly clear or uncommonly foggy; for we learn from experience, to make allowance for that variety of constitutions of the air which we have been accustomed to observe, and of which we are aware. Bishop Berkeley therefore committed a mistake, when he attributed the large appearance of the horizontal moon to the faintness of her light, occasioned by its passing through a larger tract of atmosphere; for we are so much accustomed to see the moon in all degrees of faintness and brightness, from the greatest to the least, that we learn to make allowance for it; and do not imagine her magnitude increased by the faintness of her appearance. Besides, it is certain that the horizontal moon seen through a tube which cuts off the view of the interjacent ground, and of all terrestrial objects, loses all that unusual appearance of magnitude.'

The following paragraphs illustrate the effect of *intervening objects* in aiding our perception of Distance.

'We frequently perceive the distance of objects, by means of intervening or contiguous objects, whose distance or magnitude is likewise known. When I perceive certain fields or tracts of ground to lie between me and an object, it is evident that these may become signs of its distance. And although we have no information of the dimensions of such fields or tracts, yet their similitude to others which we know suggests their dimensions.

'We are so much accustomed to measure with our eye the ground which we travel, and to compare the judgment of distances formed by sight, with our experience or information, that we learn by degrees, in this way, to form a more accurate judgment of the distance of terrestrial objects, than we could do by any of the means before mentioned. An object placed on the top of a high building, appears much less than when placed upon the ground, at the same distance. When it stands upon the ground, the intervening tract of ground serves as a sign of its distance: and the distance, together with the visible magnitude, serves as a sign of its real magnitude. But when the object is placed on high, this sign of its distance is taken away, the remaining signs lead us to place it at a less distance, and this less distance, together with the visible magnitude, becomes a sign of a less real magnitude.'

with the picture. When the two eyes view the perspective of a street, there is brought up the idea of a certain amount of walking exertion, or other locomotive measurement, as part of the perception thence arising. The two eyes looking at a footstool bring up in like manner ideas of greater or less remoteness of the parts. Now, the difficulty lies in explaining 'why two dissimilar pictures projected on the two retinæ, give rise to the perception of an object in relief.' 'It may be supposed,' says Mr. Wheatstone, 'that we see but one portion of a field of view at the same instant, the one, namely, to which the optic axes are directed, while all other points are seen so indistinctly that the mind does not recognize them to be either single or double, and that the figure is appreciated by directing the point of convergence of the optic axes successively to a sufficient number of its points to enable us to judge accurately of its form.' But observation does not confirm this supposed indistinctness of those parts for which the eyes are not adjusted; on looking at a stereoscopic view, for example, we find that we obtain a clear and distinct picture of the whole, even when the eyes are steadily fixed upon one point, during which act, by the supposition, all points nearer or farther ought to be confusedly and imperfectly perceived. Hence it is that Sir C. Wheatstone has been led to adopt the above-mentioned view of a mental suggestion coming in to present a clear and perfectly formed idea, notwithstanding the optical fact that, for many parts of the view, there actually falls upon the eyes what would be a double and indistinct image. The mind being once accustomed to fully formed views of all kinds, these are revived by the force of association, the main circumstance for determining the view being present; namely, the double aspect which our experience has always connected with a solid effect, or an effect where varying distance is conjoined with lateral extension.* This hypothesis appeals to what is undoubtedly a *vera causa* in the region of mind.

* The subject of Binocular vision has been greatly studied in Germany, and there are at present two opposite opinions as to the manner of

42. Into this matter, however, I do not enter farther than to remark, that the same circumstances that enable us to

obtaining a single perception by means of the two dissimilar pictures. Volkmann holds that the unity is arrived at, by the mind disregarding the conflicting parts of the two pictures, and attending only to their points of agreement. To him the dissimilarity is an incumbrance to be shaken off, an obstacle to be surmounted. Wundt, on the other hand, holds that the dissimilarity, far from being an obstruction, is the very instrument or medium of our motion of solidity. It is (after variation of retinal magnitude) the most suggestive of all the optical marks of a third dimension. The more pronounced the dissimilarity, the more emphatic is our sense of solidity and varying distance from the eye.

In the remarks on Double Vision under the Sense of Sight, I have proceeded upon this latter view as best supported by evidence. In the theory of Volkmann, there appears a needless anxiety on the subject of the double picture, as if it would necessarily distract us with two differing representations of one object. It is fancied that each eye sees a complete image in itself, and that the mind must reconcile these two separate images, before attaining the desired unity of perception. But there seems to be a misapprehension in so regarding the question. Each eye does not see the complete picture, but only a part of the picture; the other eye seeing the other part. We might have a body so placed to the two eyes, that the one eye should see one side and the other eye the other side; in which case the *double* impression is obviously the picture. Experience tells us that an occasion like this —where both eyes must concur to give the whole extent of the picture, or where we see more by the two than by the one—involves a retreating object, or the solid effect. It is no more necessary that the two eyes should give two complete and separate pictures to the mind, than that the two hands embracing the same ball should suggest two balls; or that the thumb and finger grasping a pen should suggest two pens. The eyes are formed to aid and supplement, and not to contradict, each other. In great distances, each eye is sufficient for taking in the view; no addition is made by their conjoint action. This circumstance is to us simply a token of a far prospect. The opposite case where the two pictures have nothing in common is interpreted as the extreme of nearness in the object.

It is in all probability the fact, that one eye takes the lead in vision, the other merely coming in to supply the additions that constitute solid effect; just as in feeling any thing, we use chiefly the right hand (or the left), and attend to its indications, while the other merely corrects or adds to the notion. Our visual ideas would thus be embodied in the sensation of one eye, while the other, making no claim, in the same individual, to have its sensation embodied separately, gives that extension of view and those adjuncts that serve in the full solid effect. Dr. Carpenter has made this remark, with reference to the binocular microscope. The observer uses one eye principally, and for that eye, it is desirable that the instrument should be as perfect as possible; the other eye has no farther use than to bring out the stereoscopic effect.

appreciate the distances of different objects, enable us also to appreciate solid effect, or the continuity of an object through varying distances. The definite change in the inclination of the axes, concurring with a definite and proportional change of the retinal magnitude (the tendency to parallelism of the axes accompanying a decrease of retinal magnitude) would suggest the real width of a street to be the same all through; upon which, the diminished picture gives assurance of the increasing remoteness of the successive parts.

A question has been raised as to our mode of perceiving the direction of an object from the eye. On this I would still repeat that direction is not a perception of sight alone; its very meaning precludes the supposition. It implies the locomotive or other movement that would lead us up to the object, or produce a definite change in its appearance. But there is a certain optical effect constantly associated with the sense of direction, as there is with the sense of magnitude or of distance, and this effect it is interesting as a matter of fact to ascertain. Now, it appears most probable that the line of visible direction is a line passing from the place of an object's impression on the retina through the centre of the crystalline lens:* hence we associate an effect on the centre of the retina with a direction in the line of the axis of the eye, while an impression to the right of this point would suggest a position left of the axis. But without the experience of our moving organs generally, we should never know, either the meaning of direction, or the fact that a certain impression of the retina implied a certain course for us to take in reference to the object. If the optical law had been entirely different; if, for example, an object were to lie in a direction inclined 45° to the plane of its image in the retina, we should equally well become acquainted with direction; experience would connect the locomotive estimate with the

* This line has been variously stated. Sir David Brewster affirms that it passes through the centre of the eye. See p. 216 of a work entitled, *Essai sur les Phosphènes, &c., par le* Dr. Serre, Paris, 1853.

visual impression as completely as is done now. The question is very much of the same nature as that of inverted vision, formerly discussed; it matters not where or how the optical effect takes place, association connects the true perception with it. In fact, when we dress by a mirror we perform a series of inversions, very difficult at first, but in the end as easy as working under direct vision.

43. *Localization of Bodily Feelings.*—The localization of our bodily feelings presents an interesting case of acquired perception. Previous to experience, we have no notion of the seat of any local sensation, as, for example, a pain in the shoulder, or the toe. It is impossible we should have such a notion intuitively, inasmuch as we must connect an internal feeling with a picture to the eye, or an estimate to the touch, of the part where the feeling arises.

Our own body is a thing exposed to all our senses, and to the sweep of our movements, like a table, or a statue, or a fowling-piece. The eye can scan nearly the whole of it; the hand can sweep over it; the legs can move over parts of it; the ear can hear the sounds it makes; the mouth and tongue can co-operate with the hand. The eyes can appreciate the colour, outline, and solidity; the mind, accustomed to the perception of size and distance, can form an estimate of the remoteness of the parts and the magnitude of the whole, the body's own various movements concurring in the estimate.

So far the body is to us an external object; but it is also the seat of sensibility of various kinds, which sensibility we can usually refer to some locality, as the head, arms, chest, &c. The question arises, how do we come to have this knowledge of locality? I answer, by experience and association, based on the distinctness of the nerve fibres supplied to the different parts. (See Touch, p. 160.) A pinch in the toe is not sensibly different in quality from a pinch in the finger; but if both were happening together, we should have a sensation of two actions, and not of a single action made stronger. This is owing to the distinctness of the nerves; and through this distinctness we can form separate associations with each. I can associate one pain with the sight of my finger, another pain with the sight of my toe, and a third with the position of my arm that determines the crown of the head. An infant at the outset knows not where to look for the cause of an irritation when anything touches it; in time, it notes a coincidence between a feeling and a pressure operating on some one part; whence a feeling in the hand is associated with the sight of the hand, and so for other members.

When the feeling is more internal, as in the interior of the trunk, we have greater difficulty in tracing the precise seat; often we are quite at a loss on the point. In such a case, we have to trust to some indications that come to the surface, or to the effect of superficial pressure on the deep parts. On receiving a hurt on the ribs, we learn to connect feelings in the chest with the place on our map of the body; we can thus make experiments on the deep-seated organs, and learn the meaning of their indications. But the more inaccessible the parts, the more uncertainty is there in assigning the locality of their sensations; if, in addition, they are not well supplied with distinctive nerves, the difficulty is still greater. The liver, the spleen, and the kidneys, are indistinct as regards the feelings connected with them. In those places on the skin where the sentient units of nerve are wide apart, as in the back, the calf of the leg, &c., we can never acquire a minute appreciation of locality; the limit of distinctness of the nerve fibres will be the limit of the acquired perception.

This association between an internal feeling and the sight or touch of the place where it originates, acts reciprocally, and produces singular effects. Fixing the eye on a part of the body, as the hand, and intently regarding it for some time, we can actually generate a sensation in the skin, by a sort of back current; the *idea*, which I conceive to be a past experience revived on the same nervous tracks, has a tendency to induce the *reality*. In the artificial sleep known as the mesmeric state, this influence has been carried to great lengths. Mr. Braid has employed it to induce healthy actions upon diseased organs, being able also to cause the opposite effect of inducing unhealthy changes.

44. *Associated differences in Sensations.*—We have seen that discrimination is a fundamental property of the intellect, and that in so far as we can note differences in our sensations, to that extent these may be called intellectual. Even in Pleasure and Pain, the nice discrimination of more or less, or of one kind as compared with another kind, is an intellectual act. If one person is sensitive to a small difference in pleasurable or painful sensibility, such as would be unfelt by another person, the one may be said to be superior to the other intellectually. Discrimination is the groundwork of all knowledge; for to know things is to be impressed with their respective *characteristic* sensations or impressions. We should not know any human beings if they all impressed us alike. A botanist sees in a meadow twenty species of grasses; an ordinary person has perhaps remarked three or four. As discrimination extends, knowledge and all its consequences extend also.

There is an important class of sensations that in themselves, or as originally felt, are precisely identical, but, by taking on different associations, become as distinct to the mind as sweet and sour in taste, acute and grave in sound, or red and green in colour. In the sense of Touch, for example, consider the two hands. If we compare the feeling of touch in the right hand with the same kind of contact in the left, we find that they are, as feelings, absolutely identical. But for intellectual purposes, they become quite distinct; they can sustain totally different associations. With a touch upon my left hand, I associate a whole field of imagery seen on my left side, and with a touch on my right hand, I associate another set of imagery in connexion with my right side. If any one pinches my right hand, I incline my head and direct my eyes to the right; if my left hand is pinched in precisely the same manner, my movements are all towards the left. The feelings seem identical in everything but association. This possibility of suspending different associations proves that there is a real difference in the sensations, that they are not confounded in the brain, though we may not trace this difference in the immediate consciousness. Association alone brings it out.*

45. The very same line of illustration can be followed with the muscular feelings. The feeling of a muscle under contraction has a uniform character all over the body, the degree of tension and all other circumstances being equal. Not to insist on the case of the two arms, or the two legs, or the rotation of the body in opposite ways, which would be similar to the foregoing illustration from touch, we can suppose a weight borne by the arm to give the same amount of muscular feeling as a pressure exerted by the foot. Under this supposition, two feelings are produced that have no difference, either as regards feeling, or as stimulating volition; yet experience shows that they are recognized as distinct by the mind. The two muscular tensions are made manifest to

* Our power of localizing our feelings of Touch and Sight has been explained differently. It is maintained in Germany by Lotze, Wundt, and others, upon the evidence of experiments, that the tactile sensations of the two hands, and of the skin everywhere, are *qualitatively* different, and that this difference of quality assists us greatly in learning to discriminate the several localities. To obviate the objection, from our not habitually recognizing any qualitative distinction in the touches in different parts of the body, it is remarked, no doubt with justice, that we are so much concerned habitually with the objective perceptions, as no longer to attend to the subjective differences. These differences may, nevertheless, at an early stage, have been sufficiently marked to form the basis of our local discriminations.

In the case of Touch, the supporters of this doctrine find some difficulty in stating what is the kind of quality whose variation is perceptible over the body generally. But in Sight, there is no such difficulty. It is laid down, on the faith of experiment, that the sensibility of the eye is locally different to colour; for if we cause the same colour to pass from the yellow spot to the distant parts of the retina, it will appear, not the same, but different; and the variation of shade would thus be a mark of the place in the retina where the impression falls. We have here something definite to proceed upon. We can institute an inquiry, as to whether the discrimination of difference of shades of colour is sufficiently delicate, to correspond with the minuteness of vision formerly described.

Some difficulty might be experienced, under such an hypothesis, in explaining how we should distinguish between an actual *succession* of colours the consciousness by different nerves; and, on this fact, the mind is able to build and maintain distinct associations, although not aware of any difference, either of quantity or of quality, in the feelings as such. We have already called attention to the articulate character of the sense of Touch, arising from the independence of the nerves of the skin, as distributed over the general surface, a remark applicable also to the nerves supplied to the different muscles. The same kind of feeling, coming from different parts, is recognized as different by taking on different associations. Before any associations are formed, the difference is latent; after the growth of distinctive connexions it is unmistakeable. The localizing of our feelings—the possibility of assigning a locality to each—is founded on this distinctness of the nerves arising from different parts. If a prick in the leg and a prick in the arm were as undistinguishable in every way, as they are to the mere sense of pain, we should never be

and the *same* colour passing over different fibres. I do not say that this is an insuperable obstacle, if it could be shown that our ability to distinguish nice gradations of colour is such as to approach the observed limits of fineness of vision. Between the centre of the yellow spot, and a point in the retina, say 10° removed from it, we should require to interpolate, at the very least, several hundreds of shades of redness passing into green or blue. I am not prepared to affirm that this is impossible to the primitive eye; but it is hardly consistent with our ordinary estimate of the powers of the eye, even in persons educated to the discrimination of colours. Still, the hypothesis is one that deserves to be entertained; it is in some respects, perhaps, less difficult than the assumption of a sense of difference in feelings qualitatively identical, an assumption supported only by its being adequate to account for the facts of local discrimination.

The supposition of latent qualitative differences, where to the common apprehension there is nothing but sameness, must, it would seem, be likewise extended to the muscles. It would have to be shown that there is something distinct in the muscular feelings of the two arms exerted exactly in the same way. When muscles are of very different magnitude and calibre, as the deltoid of the shoulder, the biceps of the arm, the diaphragm, and the orbicular muscle of the mouth, I can readily suppose that we should be differently affected by their contraction; the difficulty consists in assigning a characteristic peculiarity in the feeling of expended energy in two muscles in all respects resembling, as in those of the two sides of the body, and in others almost identical in size and in form.

able to connect the one with our notion of the leg, and the other with our notion of the arm, or with any of the other distinctive features of those two members.

If not superfluous, after these examples, the eye might be adduced to the same effect. The place of the retina impinged upon by a ray of light, is, in the main, unimportant as respects the feeling of light, but there is, notwithstanding, a real difference in the intellectual point of view, brought out, as in the other cases, by association. We can thus discriminate right and left, up and down, centre and circumference, in our field of view, as soon as any characteristic actions, or consequences, become connected with the different portions of the retina impinged upon from these various outward positions of the rays of light. The retina is in this respect identical with the skin; it consists of a number of independent nerve fibres, each transmitting the same quality of impression (unless the theory of qualitative differences can be established), but to a distinct region of the common centre of visual impressions, and so as to form the starting point of a perfectly distinct series of accompanying impressions. A man at a telegraphic station, under the old system of signals, saw the same arm repeated to his view; but, with its picture on the lower part of the retina he connected one action, on the upper part another action. This is associated discrimination.*

* *Sir William Hamilton's theory of the inverse relation between Sensation and Perception.* This theory has been stated by its author as follows:—'*Though a perception be only possible under condition of a sensation; still, above a certain limit the more intense the sensation or subjective consciousness, the more indistinct the perception or objective consciousness.*' By the 'sensation' is here meant the feeling as regards pleasure or pain; by the 'perception' I understand what is termed above the intellectual discrimination; the difference is like that between the excitement of a blaze of sunshine and the discrimination of two natural history specimens. These two effects Sir William Hamilton believes to be inverse to one another; that is, in proportion as the one is strong the other is weak. I am disposed to admit the truth of this doctrine to a very considerable extent. But it appears to me that the facts as to the relation of these two qualities—the emotional on the one hand, and the intellectual on the other—show a greater degree of complexity than

ASSOCIATES WITH FEELING.

46. The element of Feeling, or pleasure and pain, viewed as such, enters into alliance with the more intellectual states of mind, as, for example, those neutral perceptions of outward things that we have just been considering. This alliance or association between feeling and imagery gives rise to a number of interesting phenomena, some of which may be introduced here, as presenting a new case of the associating process.

In the pleasures and pains derived through the various senses and through the moving organs, associations spring up with collateral things, the causes or frequent accompaniments

this law expresses, even although it be correct as to the prevailing character of the relation.

The following extract contains the statement of the facts adduced in support of this theory by its author. 'If we take a survey of the senses, we shall find, that exactly in proportion as each affords an idiopathic sensation more or less capable of being carried to an extreme either of pleasure or pain, does it afford, but in an inverse ratio, the condition of an objective perception more or less distinct. In the senses of Sight and Hearing, as contrasted with those of Taste and Smell, the counter proportions are precise and manifest, and precisely as in animals these senses gain in their objective character as means of knowledge, do they lose in their subjective character as sources of pleasurable or painful sensations. To a dog, for instance, in whom the sense of smell is so acute, all odours seem, in themselves, to be indifferent. In Touch or Feeling the same analogy holds good, and within itself; for in this case, where the sense is diffused throughout the body, the subjective and objective vary in their proportions at different parts. The parts most subjectively sensible, those chiefly susceptible of pain and pleasure, furnish precisely the obtusest organs of touch; and the acutest organs of touch do not possess, if ever even that, more than an average amount of subjective sensibility.—The experiments of Weber have shown, how differently in degree different parts of the skin possess the power of touch proper; this power, as measured by the smallness of the interval at which the blunted points of a pair of compasses, brought into contact with the skin, can be discriminated as double, varying from the twentieth of an English inch at the tip of the tongue, and a tenth on the volar surface of the third finger, to two inches and a half over the greater part of the neck, back, arms, and thighs. If these experiments be repeated with a pair of compasses not very obtuse, and capable, therefore, by a slight pressure, of exciting a sensation on the skin, it will be found, that whilst Weber's observations, as to the remarkable difference of the different of those feelings. Thus we connect the pleasures of repose with an easy chair, a sofa, or a bed, and the pleasures of riding with a horse and carriage. The sight of food recalls a certain part of the pleasure of eating. The preparation of meals and the catering for the table are interesting avocations, through a reference to the end they serve. The representation to the eye of fragrant flowers in a painting, has power to revive some of the pleasures that we gain from the reality through the sense of smell. The pleasures of music, in so far as they can be enjoyed in the retrospect, are evoked by association.

We have seen that it is a quality of some feelings to be more recoverable in idea than others; for example, the

parts in the power of tactile discrimination, are correct; that, at the same time, what he did not observe, there is no corresponding difference between the parts in their sensibility to superficial pricking, scratching, &c. On the contrary, it will be found that, in the places where, objectively, touch is most alive, subjective feeling is, in the first instance at least, in some degree deadened; and that the parts the most obtuse in discriminating the duplicity of the touching points, are by no means the least acute to the sensation excited by their pressure.

'For example;—The tip of the tongue has *fifty*, the inferior surface of the third finger *twenty-five* times, the tactual discrimination of the arm. But it will be found, on trial, that the arm is more sensitive to a sharp point applied, but not strongly, to the skin, than either the tongue or the finger, and (depilated of course) at least as alive to the presence of a very light body, as a hair, a thread, a feather, drawn along the surface. In the several places the phenomena thus vary:—In those parts where touch proper prevails, a subacute point, lightly pressed upon the skin, determines a sensation of which we can hardly predicate either pain or pleasure, and nearly limited to the place on which the pressure is made,' &c.—*Edition of* REID, p. 863.

On these last experiments I would remark, first, that the tongue is scarcely a fair subject of comparison with the skin, seeing that the two tissues are not of the same nature; a matter of considerable importance as regards a pleasurable or painful irritation; and, therefore, the fairest mode of conducting the trial is skin with skin.

Secondly, if trial were made of the cheek compared with the other parts, the inverse proportion contended for would not hold good. To a prick, or a smart blow, the cheek is at least as sensitive as any portion of the skin whatever; but it is certainly not the least discriminating in Weber's scale. In fact, it stands high in the scale, being equal to the palm of the hand and the extremity of the great toe, and inferior only to the tongue, lips, and fingers.

pleasures of music and of spectacle are recovered from the past more completely than the pleasures of exercise, repose, warmth, or repletion. When those higher feelings are revived, by means of association, a much greater approach is made to the intensity of the actual experience.

47. It will not be out of place to select a few examples of the association of the deeper emotions of the mind with the notions that we have of outward things, by which connexion these emotions also can be made present in the absence of their proper stimulus. The emotions of Tenderness, Self-complacency, Irascibility, Terror, &c., when stimulated repeatedly in the presence of some one object, enter into mental partnership with that object; and the two individuals of the couple are thenceforth able to revive each other, the

In this case, therefore, the inverse ratio of sensibility and discrimination does not subsist.

Taking the cheek and the back of the hand as compared with the palm of the hand, one would be disposed to say that the sensitiveness to pain varied with the structure of the cuticle, while the discrimination depends solely on the supply of nerves. Let the cuticle be thickened as in the hand and foot; the parts are rendered obtuse to a blow. But where the cuticle is thin, the skin is correspondingly tender or susceptible to painful or pleasurable irritation. This is a popular belief, whether scientifically true or not. Any one keenly alive to a smart or an attack is said to be *thin-skinned.* In addition to this, I am disposed to believe that the parts nearest the brain are in consequence more sensitive than remote parts. The agonies of toothache, face-ache, pains of the nose and ear, appear to be more intense than would arise from similar irritations in the lower extremities. If this be a general rule, the skin of the face would be more sensitive than the skin of the arm or the hand, and these more than the leg or foot.

In so far as the differences of sensibility and discrimination depend on the *mind,* Sir W. Hamilton's theory of inverse relation is more strictly applicable. It is to me quite evident that, if the whole mind and attention be concentrated on the sensation as a feeling, as giving pleasure or pain, there will be a lack of attention to the intellectual quality. But then it is possible that the mind should be awake to both qualities, and to the one for the sake of the other. This is true within certain limits of intensity of sensation.—(See p. 75.)

Mr. Spencer has criticised the doctrine of Hamilton (Psychology, p. 279), and has summed up the result in the following sentence:—'Generalizing the facts, then, it would seem, not so much that Sensation and Perception vary inversely, as that they exclude each other with varying degrees of stringency.'

object recalling the emotion, and the emotion restoring the object.

The emotion of Natural Tenderness is brought out chiefly towards sentient beings, and, after a time, arises habitually in connexion with certain persons or living creatures, who are then said to be objects of affection or attachment. The feeling, moreover, overflows upon places and things, instigating a tender regard towards inanimate nature. The associations with home, with one's native spot, with the tokens of friendship and the relics of the departed, are made powerful by all the causes that give force to the contiguous bond. The natural abundance of the emotion in the character, repetition, a good natural adhesiveness, the disposition to cultivate this peculiar region of associations—all contribute to strengthen the link that enables persons or things to diffuse tender feeling over the mind. We may suppose some mental constitutions to have a natural retentiveness for special emotions, just as there are intellects retentive of visible pictures, music, or language; this retentiveness not being identical with the strength of the emotion in the reality. Such persons would be peculiarly qualified to cultivate associated feeling, to derive pleasure from the relics and the memory of affection, and to make this pleasure an object of pursuit in life.

The illustration for objects of hatred and aversion, and for all the outgoings of the Irascible passion, would be an exact parallel. This passion connects itself with persons, with places, things, events, &c.; and may then be revived by objects that of themselves have no original power to stir it up. We are apt to feel an aversion to places where we have suffered deep injuries, and to the unwitting instruments of calamity and wrong.

Egotistic and Selfish emotion diffuses itself over all matters related to self; and the objects that a man surrounds himself with, come to reflect the sense of his dignity and importance. According as this feeling is indulged, associations grow up between it and a great variety of things. Possessions, office, the fruits of one's labour, the symbols of rank, are all over-grown with this connexion, and radiate the feelings of self-complacency and importance to the mind. The members of one's family are objects not simply of tender affection, but of affection and egotism combined. So with friends, and with all the objects of our habitual admiration. It is impossible to be in the constant practice of loving or admiring anything, without coming at last to connect the object with self; the disinterested emotion that first attracts us to persons, becomes, by indulgence, interested affection.

48. The pleasure of *money* is a remarkable instance of associated feeling. The sum total of purchasable enjoyments becomes linked in the mind with the universal medium of purchase, and this medium grows into an end of pursuit. In the first instance, we are stimulated by these other pleasures, but an affection is often generated at last for money itself. This transfer is brought about when we allow ourselves to be so engrossed with the *pursuit* of wealth, that we rarely advert to the remote ends or the purchasable pleasures; the mind dwelling solely on the one object that measures the success of our endeavours. A moderate pursuit of gain that leaves the mind free to dwell upon the pleasures and advantages that money is to bring, does not generate that intense affection for gold as an end constituting the extreme form of sordid avarice.

Another example of an association, displacing the original source and purpose of a feeling, is seen in connexion with the *forms* of business. Book-keeping, legal formalities, and technical procedure, are intended as aids to the transaction of business. In themselves nothing, they have a great value in furthering our substantial ends, and we contract a sentiment towards them on that ground. As with money, however, this reflected interest sometimes detaches itself from the original ends; and we take a pleasure in maintaining formalities that time and change have reduced to an empty letter.

49. *Alisonian Theory of Beauty.*—This celebrated doctrine exemplifies the case of contiguous association now in hand,

in so far as we are disposed to admit the applications that its author makes of it. That he has carried his theory of associated pleasure too far might, I think, be shown in numerous instances. We have already seen that all the senses yield us sensations that are in themselves pleasurable, without reference to any associated effect. There are fragrant odours, sweet sounds, and pleasing effects of light and colour, in which the pleasure is owing to a direct and immediate action of the objects upon the organs of sense; and these pleasurable feelings never fail to be produced when we are in a condition to enjoy them. There would be nothing permanently or generally pleasing, if we had not a certain number of such primary sources of enjoyment.

But the doctrine of Alison satisfactorily explains the strong effects often produced on our minds by sensations and objects, in themselves indifferent, or wholly unequal to those effects. A few instances of this sort may be quoted as true examples of borrowed or associated emotion. To take the case of sounds: 'All sounds,' says Alison, 'are in general SUBLIME, which are associated with ideas of great Power or Might; the Noise of a Torrent; the Fall of a Cataract; the Uproar of a Tempest; the Explosion of Gunpowder; the Dashing of the Waves, &c.' Most of these sounds, however, are intrinsically impressive from their intensity and volume, and the effect that they have on the mind is not wholly due to association. The following is a better selection for the purpose in hand. 'That the Notes or Cries of some Animals are Sublime, every one knows; the Roar of the Lion, the Growling of Bears, the Howling of Wolves, the Scream of the Eagle, &c. In all these cases, those are the notes of animals remarkable for their strength, and formidable from their ferocity.' In like manner, the author exemplifies associations with the feeling of Beauty, as follows:—'The Bleating of a Lamb is beautiful in a fine day in spring; the Lowing of a Cow at a distance, amid the scenery of a pastoral landscape in summer. The call of a Goat among rocks is strikingly beautiful, as expressing wildness and independence.

The Hum of the Beetle is beautiful on a fine summer evening, as appearing to suit the stillness and repose of that pleasing season. The Twitter of the Swallow is beautiful in the morning, and seems to be expressive of the cheerfulness of that time. A similar illustration can be derived from Colours and appearances to the eye.' The impressive emotion roused by the discharge of thunder can be evoked by the transient flash in the window, an effect in itself very trivial, but able to recall the grander features of the phenomenon, and through these the emotion of the Sublime. The relics of a storm, seen in the disorder and wreck, revive the feeling impressed by the height of its fury. The language that describes such phenomena, when aptly used, can arouse the emotions purely by the force of association.

Alison extends the illustration of his doctrine to Forms and Motions, as well as sounds and colours, and supplies examples in great abundance under all these heads. I believe he has here too, in many instances, put forward intrinsic effects as the effects of association; but, nevertheless, he has put it beyond dispute, that the associating principle operates largely in clothing *indifferent* objects with a power to raise motion in the mind of the beholder.

There is, I am satisfied, a *primitive* influence in form to produce a certain amount of emotion, of the kind that enters into the compositions of Art. Curved forms and winding movements yield, of themselves, a certain satisfaction through the muscular sensibility of the eye. Yet we must add to this original impressiveness an influence of association; namely, the connexion of Ease and *abandon* with the curve line, and of Constraint with the straight line. The free natural movements of the arm make circular figures; to draw a straight line requires an effort.

In everything of the nature of a Tool or a Machine, there are certain appearances that are pleasing to behold, as suggesting Fitness and Ease in their application to the end. A clear polish upon steel has this effect, while rust is painful from the suggestion of a harsh grating action. So the absence of noise, in the working of a machine, gives us the agreeable feeling of smooth, easy action.

50. *The Reading of Emotional Expression.*—An interesting case of associated feeling is our being able to interpret the signs of feeling in our fellow-beings, by which we are not merely made aware of their state of mind, but also derive a large amount of painful and pleasurable feeling to ourselves. The influence of the smile or the frown, so powerful in human life, is purely an associated influence. There is nothing intrinsic in the lines and forms of feature, displayed in the act of smiling, to cause the pleasure occasioned by this manifestation. Incidentally, fine forms and curves may be produced in a face, and there may be a display of beautiful tints over and above, but when these things occur they constitute an additional pleasure.

The meaning of a smile, together with the susceptibility to the cheering influence of it, are learnt among the early acquisitions of infancy. The child observes that this expression accompanies the substantial pleasures that need no association to give them their character. The smile of the parent, or of the nurse, means all the agreeables of food, dress, play, spectacle, excitement, society. The frown is as invariably connected with privation and pains. An enduring association thus obtains between one cast of features and all the good things of life, and between another expression and the ills that human power can inflict; and hence the one is able to diffuse a gladdening influence, while the other tends to excite a feeling of depression and gloom. All through life we are subject to these influences of associated emotion. So, there are tones of voice that, in the same way, can cause pleasure or pain by a power of suggestion. In this case, however, there is a certain intrinsic efficacy in the tones usually adopted to convey the intended effect. For conveying love and approbation, we choose our soft and gentle tones; for the opposite, we are led, both by passion and by choice, to use tones that are painful and grating. There is no original or intrinsic difference of effect between pleased and angry features, but, in vocal utterance, there is a manifest suitability of some tones for pleasing expression, and of others for the reverse.

It is a part of our pleasures to see happy beings around us, and especially those that have the power of expressing their feelings in a lively manner. Children and animals, in their happy moods, impart a certain tone of gaiety to a spectator. On the other hand, the wretched, the downcast, and the querulous, are apt to chill and depress those in their company. There is a satisfaction in merely beholding, or even in imagining, the appearances and accompaniments of superior happiness, which probably accounts in part for the disposition to do homage to the wealthy, the powerful, the renowned, and the successful among mankind.

Associated emotion is the medium of *sympathy* with the feelings of others. We have to acquire the signs of feeling, in order to make the states of others our own. We learn the natural appearances of the different emotions, and also the names that describe them, which appearances and names are the medium for realizing them. As in all else, there are great individual differences of progress in this acquirement, and corresponding differences in the power of sympathy.

Among the associations of Feeling, we should not omit the important sentiments of *moral approbation* and *moral disapprobation.* These are admitted on all hands to be greatly the result of education; indeed, the fact is too notorious to be controverted. The well-trained child constantly finds certain acts spoken of with marked disapprobation, and visited with pain, which gives to disapprobation its meaning; and there grows up, as a consequence, a strong association between those actions and the feelings of dread and aversion. A high motive power is thus generated for abstaining from lying, theft, cruelty, neglect of studies, and other forbidden acts. This is one side of our moral education. The other side is, in like manner, a series of associations between certain actions and praise, approval, or reward;

and these determine the acquired sentiment of moral approbation. How little of either of the two modes is to be found where nothing has been done to impress them, is best known to those that concern themselves with the outcasts of society.

The rate of advancement in moral training depends on several circumstances. In the first place, the energy of the impulses that trespass against the laws of society may be strong, or they may be weak, by nature. But, secondly, a still greater importance is to be attached to the aptitude for vividly retaining the penalties, and expressed disapprobation, of wrong. This memory for good and evil appears to be a special, or local, mode of retentiveness, as much so as colour or music; it does not always accompany high intellect generally, and it is occasionally strong, when the power of recollection in other things is weak. It belongs, no doubt, to the same circle of sensibilities that includes our prudential and our sympathetic regards. For both prudence and sympathy must concur to a well developed moral sense.

There are many of our strong likings on the one hand, and strong antipathies on the other, that come under the class of reflected influences. The sight of blood affects some persons to fainting, which cannot be owing to anything in the mere appearance of it; apart from association, the rich scarlet hue would make this a really agreeable object to the eye.

ASSOCIATIONS OF VOLITION.

51. I have already adverted to the mistake, committed by Reid, in pronouncing the voluntary command of our limbs and other moving organs instinctive. If we observe the movements of infancy, we see plainly that, for many months, there is no such thing as a command of the active members, in obedience to an aim or purpose present to the mind. An infant may have sufficient intelligence to form a wish, and be quite unable to execute the simplest movements

for attaining the thing wished. A common example of this is the attempt to seize something with the hand, as a spoon; we see the most awkward movements occurring, evidently from the entire want of any definite direction of the limbs at that stage. This definite direction is acquired; and the acquisition is the most laborious and difficult of all human attainments. The performance of the simple movements that we wish to perform, is the basis of our acquirement of more complex movements at a subsequent stage; but our first education is self-education. Until a child can, of its own accord, put out its hand and seize an object before its eyes, which for the first few months it cannot do, any attempt to direct it is in vain; and, until, of its own accord, it can move its own body as it sees something else moved, it has not begun to be an educable being.

The voluntary command of the organs implies the following things. 1st, The power of *continuing* or *abating* a present movement in obedience to a present feeling, as when the child sucks while the appetite is gratified, and ceases when satiety comes on. We have referred this to a primary law of the animal organization, namely, that pleasures are accompanied with an increase, and pains with a diminution, of the vital energies. So far, Volition is an Instinct. 2ndly, The power of *selecting* a movement in order to heighten or abate a present feeling, as when the child directs its head and mouth to seize the nipple, and begins sucking. There may be a few instances of instinctive movements of this kind, but in general they are acquired, being determined by means of association. The coincidence of the movement and the feeling must be at first accidental; the movement springing up of its own accord, and finding itself able to control the feeling, the two become after a time so firmly connected that the one suggests the other. Thus the movement of the eyes and head is at first spontaneous, but the agreeable feelings of light brought on by these movements prompt their continuance, and the pleasure grows to be associated with these movements; whereupon, when this feeling is present to the mind as a wish, it prompts the requisite exertions. Thus it is that a child learns to search out a light in a room in order to enjoy the maximum of the illumination; it learns to turn its view to the fire, or the window, or to some face that it has begun to recognize agreeably. Volition means, 3rdly, the performance of some *intermediate* actions with a view to our gratification; as when things are seized with the hand in order to be carried to the mouth, and when animals, descrying their food at a distance, set themselves to move forward to lay hold of it. These intermediate actions are most manifestly the result of experience, in the human subject at least. The power of locomotion has first to be developed; the exerting of the power then becomes associated with its various consequences, and among others that of bringing the individual within reach of the objects of its desires. 4thly, The voluntary command of the organs means the power of *imitation*, or of performing actions in consequence of seeing them performed. Here a link has to be established between a certain appearance to the eye and the movement of corresponding organs in the individual's self. In the case of vocal imitation, a sound is the antecedent of an utterance, each sound heard being associated with a distinct movement of the chest and larynx, under the proper attitudes of the mouth. It is not uncommonly supposed that imitation, both of actions and of sounds, is instinctive; but I believe this to be incorrect. 5thly, Under volition we include the power of moving our organs merely on *the wish* to see them moved; as when I look at my hand, and will to raise it. Here a connexion is formed between the sensible appearance of any member, or the idea left by that sensible appearance, and its being moved. Lastly, we can make a movement on being directed to do so, by *the part being named;* 'up head,' 'down hands,' &c. This is a further association, formed between certain names or sounds and a particular class of movements. All these various actions are employed in the most elementary efforts of the will to control the body. Others could be named that transcend their range of influence, as, for example, the control of the passions and the command of the thoughts.*

* The following are notes of observations made upon the earliest movements of two lambs seen during the first hour after birth, and at subsequent stages of their development. The two came from the same mother, and their actions were in the main alike.

One of the lambs, on being dropped, was taken hold of by the shepherd, and laid on the ground so as to rest on its four knees. For a very short time, perhaps not much above a minute, it kept still in this attitude. A certain force was doubtless exerted to enable it to retain this position; but the first decided exertion of the creature's own energy was shown in standing up on its legs, which it did after the pause of little more than a minute. The power thus put forth I can only describe as a spontaneous burst of the locomotive energy, under this condition, namely, that as all the four limbs were actuated at the same instant, the innate power must have been guided into this quadruple channel in consequence of that nervous organization that constitutes the four limbs one related group. The animal now stood on its legs, the feet being considerably apart so as to widen the base of support. The energy that raised it up continued flowing in order to maintain the standing posture, and the animal doubtless had the consciousness of this flow of energy, as its earliest mental experience. This standing posture was continued for a minute or two in perfect stillness. Next followed the beginnings of locomotive movement. At first a limb was raised and set down again, then came a second movement that widened the animal's base without altering its position. When a more complex movement with two limbs came on, the effect seemed to be to go sideways; another complex movement led forwards; but at the outset there appeared to be nothing to decide one direction rather than another, for the earliest movements were a jumble of side, forward, and backward. Still, the alternation of limb that any consecutive advance required, seemed within the power of the creature during the first ten minutes of life. Sensation as yet could be of very little avail, and it was evident that action took the start in the animal's history. The eyes were wide open, and light must needs have entered to stimulate the brain. The contact with the solid earth and the feelings of weight and movement were the earliest feelings. In this state of uncertain wandering with little change of place, the lamb was seized hold of and carried up to the side of the mother. This made no difference till its nose was brought into contact with the woolly skin of the dam, which originated a new sensation. Then came a conjunction manifestly of the volitional kind. There was clearly a tendency to sustain this contact, to keep the nose rubbing upon the side and belly of the ewe. On finding a certain movement to have this effect, that movement was sustained; exemplifying what I consider the primitive or fundamental fact of volition. On losing the contact, there was as yet no power to recover it by a direct action, for the indications of sight at this stage had no meaning. The animal's spontaneous irregular movements were continued;

52. In order to illustrate the acquired character of these several voluntary actions, excepting always the first, I shall

for a time they were quite fruitless, until a chance contact came about again, and this contact could evidently sustain the posture or movement that was causing it. The whole of the first hour was spent in these various movements about the mother, there being in that short time an evident increase of facility in the various acts of locomotion, and in commanding the head in such a way as to keep up the agreeable touch. A second hour was spent much in the same manner; and in the course of the third hour, the animal, which had been entirely left to itself, came upon the teat, and got this into its mouth. The spontaneous workings of the mouth now yielded a new sensation, whereby they were animated and sustained, and unexpectedly the creature found itself in the possession of a new pleasure; the satisfaction first of mouthing the object—next, by-and-by, the pleasure of drawing milk; the intensity of this last feeling would doubtless give an intense spur to the co-existing movements, and keep them energetically at work. A new and grand impression was thus produced, remaining after the fact, and stimulating exertion and pursuit in order to recover it.

Six or seven hours after the birth the animal had made notable progress. Locomotion was easy, the forward movement being preferred, but not predominant. The sensations of sight began to have a meaning. In less than twenty-four hours, the animal could, at the sight of the mother ahead, move in the forward direction at once to come up to her, showing that a particular visible image had now been associated with a definite movement; the absence of any such association being most manifest in the early movements of life. It could proceed at once to the teat and suck, guided only by its desire and the sight of the object. It was now in the full exercise of the locomotive faculty; and very soon it could be seen moving, with the nose along the ground in contact with the grass, the preliminary of seizing the blades in the mouth.

I am not able to specify minutely the exact periods of the various developments in the self-education of this lamb, but the above are correct statements to the best of my recollection. The observations proved distinctly these several points, namely, first, the existence of spontaneous action as the earliest fact in the creature's history; second, the absence of any definite bent prior to experienced sensations; and third, the power of a sensation actually experienced to keep up the coinciding movement of the time, thereby constituting a voluntary act in the initial form. What was also very remarkable, was the rate of acquisition, or the rapidity with which all the associations between sensations and actions became fixed. A power that the creature did not at all possess naturally, got itself matured as an acquisition in a few hours; before the end of a week, the lamb was capable of almost anything belonging to its sphere of existence; and at the lapse of a fortnight, no difference could be seen between it and the aged members of the flock.

select the case of Imitation. If we can prove satisfactorily that this is not instinctive, but acquired, little doubt will remain on the other cases.

(1.) The first argument against instinctive imitation is the fact, that no imitation whatever takes place during the first few months of infant existence. So far as my observation goes, there is very little during the first year. But a primitive impulse ought to appear much earlier. The instinctive movements discussed in the preceding Book show themselves from the very commencement of life. There is no new development or manifestation of power at the time when the imitative propensity comes on ; there is nothing parallel, for example, to the physical changes that show themselves at puberty, along with the new feelings of that period. The child is seen to go through a great deal of active exertion of its own, in the course of those unimitative months ; the power of repeating the actions of others would be exceedingly valuable at this time, and would save much fruitless endeavour ; but the very faintest tendency in this direction cannot be discerned. There may be instances of a more precocious faculty than any that I have observed, but these would not affect the present argument.

(2.) In the second place, imitation, when it does begin, is slow and gradual in its progress, a fact that looks like acquisition, and not like instinct. We find, for example, that, in speech, the imitation is at first limited to one or two articulations, and that others come on by degrees at considerable intervals. If there were any primitive connexion in the brain between a sound heard, and the reproduction of that sound with the voice, it ought to be as good for one letter of the alphabet as for another. So with the movement of the hand ; why should one be possible, while no amount of example will bring out a second, not in itself more difficult ?

(3.) The imitation very often fails after it has once been hit. A child has caught a certain sound, and will at particular times produce it ; yet at other times there is no possibility of bringing on the utterance. This is constantly seen in the first efforts of children. It is in vain that we repeat to them a sound, a letter, or a syllable that they have shown themselves able to pronounce; the association between the audible impression and the specific vocal exertion has plainly not yet been formed; it cannot therefore be instinctive. The child has, in the course of its spontaneous articulate movements, come on the sound *hum*, and this sound once pronounced is likely to recur in the cycle of its spontaneous actions; but to utter the syllable at the instance of another person's utterance is something additional. As an acquisition, I can easily render to myself an account of the process. The sound spoken is also heard; besides the vocal exertion, there is a coincident impression on the ear; an association grows up between the exertion and the sensation, and, after a sufficient time, the one is able to recall the other. The sensation, anyhow occurring, brings on the exertion; and when, by some other person's repeating the syllable, the familiar sound is heard, the corresponding vocal act will follow. Experience, I think, proves that the time elapsing between the ability to utter a sound, and the readiness to utter it on its being heard, corresponds to the time requisite for an adhesion to grow up between the two heterogeneous elements, the one a spontaneous action, the other a sensation. These early sounds come out more frequently of themselves, than under the stimulus of imitation, which proves that the exertion precedes the power of imitating.

If imitation be instinctive, there must be several thousands of instinctive connexions between sensations and actions. The sound of each letter of the alphabet, and every word, would require to be connected, by a primitive adhesion, with definite movements of the larynx, the mouth, and the chest. Every movement of the hand would need to be associated with the visible appearances of the same movement in other human beings. We should have to affirm the manifest absurdity that associations could be formed between things yet unexperienced; between sounds, and sights, and actions, long before anything had been heard, seen, or done.

(4.) It is notorious to observation, that more is done by the nurse imitating the child, than by the child imitating the nurse. When an articulation is stumbled on, it is caught up by all around, and the child is made familiar with the sound as proceeding from other voices, in addition to its own. This would obviously promote the growth of the needful adhesive connexion.

(5.) Imitation varies with the natural abundance of spontaneous activity, being most efficient where the spontaneous variety and flexibility are good. A child will learn to imitate singing, in proportion as, of its own accord, it falls into musical notes. Its own native song must come first : the goodness of that will be a condition of its acquiring the song of others. In whatever department any individual shows spontaneous and unprompted facility, in that department will the same individual be imitative or acquisitive.

(6.) Imitation advances with the acquired habits. In learning to dance, the deficiency of the association between the pupil's movements and the sight of the master's, renders the first steps difficult to acquire. The desired movements are not naturally performed at the outset. Some movements are made ; sufficient voluntary command of the limbs and body has been acquired, in other shapes, to set a-going action of some kind ; but the first actions are seen to be quite wrong ; there is a manifest want of coincidence, which originates new attempts; and these failing, others are made, until at last the posture is hit. The grand process of trial and error brings on the first coincidence between a movement, and the appearance of that movement in another person ; repetition, by constituting a cohesive link, makes the imitation at last easy. Upon this acquisition, other acquisitions of the same kind are based, and the improvement is accelerating. Thus it is that we pass through an alphabet of imitation in all arts ; the fixing of the association in the first links is the most difficult part of the process.

(7.) It is in harmony with all that has now been advanced, that imitation depends likewise on the delicacy of the sense that perceives the effect.

This is not the place to exhaust the subject of Imitation in particular, or the acquisitions that enter into volition in general. It is enough, for the present, to show that the associative principle is an indispensable requisite here as elsewhere. All the conditions already specified, as affecting the rate of adhesiveness in other acquirements, might be exemplified likewise in these. The great peculiarity in their case arises from the circumstances of their commencement. Being the starting point of every other branch of education, they must find their own way through struggles and accidents, trials and failures. Reposing upon the great fundamental link between consciousness and present action,—between pleasure or pain, and the activity happening at the time,—they come at last to supply definite connexions between our feelings and exertions, so as to enable us not merely to control a movement at work, but to call dormant actions into being at the instance of our reigning desire.

Of the various circumstances affecting the progress of these volitional associations, the engagement of the cerebral energy or concentrated attention is of signal consequence. This condition, necessary at any age, seems the all-important one in the early months of our existence. The moment of an acquisition seems generally to turn upon some happy concurrence of aroused attention, or mental engrossment, with the action; if an impression is not detained for a time by the influence of some feeling, it is void of effect. When the child hits upon an exercise that gives it pleasure, and is thereby led to repeat the act, earnestly and intently, the occasion is sure to bring a sensible advance in fixing the whole connected train.

NATURAL OBJECTS—AGGREGATES OF NATURAL QUALITIES.

53. One of the principal components of human intelligence is our permanent hold of the external, or object, world as it strikes the senses.

External things usually affect us through a plurality of senses. The pebble on the sea shore is pictured on the eye as Form and Colour. We take it up in the hand, and thereby obtain the impression of Form, together with the Tactile sensation of the Surface. Knock two together, and there is a characteristic Sound. To retain the impression of an object of this kind, there must be an association of all these different effects. Such association, when matured and firm, is our idea, our intellectual grasp of the pebble.

Passing to the organic world, and plucking a rose, we have the same effects; form to the eye and to the hand, colour and touch, with the addition of odour and of taste. A certain time is requisite for the coherence of all these qualities in one aggregate, so as to give us the enduring image of the rose. When fully acquired, any one of the characteristic impressions may revive the others; the odour, the sight, the feeling of the thorny stalk,—each of these by itself will hoist the entire impression into the view. Should we go to work and dissect the flower botanically, we obtain new impressions to enter into the common aggregate.

It is by rapidly associating these qualities, in other words, by the ready adhesion of impressions of sight, touch, and the other senses,—that a person becomes largely conversant with Mineral, Vegetable, and Animal bodies. In the mind of the Naturalist, the sensations of sight and of touch, more especially, must take a ready hold. A good general adhesiveness, aided by the special or local susceptibilities, is chiefly to be depended on. The element of concentration of mind must be present likewise, in the shape of an interest for the study. To this requisite, however, we must attach an important qualification. When a department of acquisition involves a great mass of detail, the attention, spread over a wide area, cannot be strongly concentrated at any point; the concentration must be relative to alien subjects which excite no interest at all. The natural or unprompted adhesiveness, whether from general or from local endowment, is called for alike in Natural History and in Languages.

The power of observation ever fresh and buoyant, the energy of the brain thrown into visual and tactile sensation, are characteristics not of the naturalist alone, but of all men that deal with outward things in the concrete; as the engineer, the military commander, and the poet. In those things that appeal to other senses also—as articles of food—there is an additional motive, growing out of their special interest. So, there may be a superadded charm of the artistic kind, determining a preference, with some minds, for all objects of a nature to gratify the artistic sensibilities. But the naturalist should be above such partialities; to him every natural object must possess a moderate interest, and no one more than a fair share; it is only by this moderation that he can keep his mind equal to the multitude and variety of nature.

54. From the objects of the world thus apprehended, as they strike the immediate sense, we pass to a higher group of aggregates,—things with properties not always present to the view. For example, a cup in its completeness must be conceived as *containing* something, as serving this purpose or use. We have to associate with the permanent sensible qualities this other quality of usefulness for some *end*, which has a special interest in it to quicken our retentiveness of the entire total. Furniture and tools and implements of every description have this superadded quality, which, however, instead of burdening the memory, rather lightens it by the spur of a special interest. All related objects are more easily fixed in the mind than those that are unrelated, particularly if the relation be an interesting one. A monarch is more impressive than a man; a millstone is more firmly remembered than a useless block on a moor. When the interest in industrial production is naturally high in an individual, every kind of machine arrests the regards and makes a stronger impression. We have here another example of that select or special attention, which concentrates the mind upon some things to the neglect of others, and is also in strong contrast with the catholic tendencies of the naturalist mind. Not only is there a restriction as regards the objects in the narrow point

of view, but the properties attended to are more limited. If a tool has a good edge, its specific gravity is a matter of indifference; if a quarry yields good building stone, the owner leaves it to others to determine its mineral composition and its geological era.

NATURAL AND HABITUAL CONJUNCTIONS—STILL LIFE.

55. The things about us that maintain fixed places and relations, become connected in idea as they are in reality, and we thus lay up a phantasmagoric representation of our habitual environment. The house we live in, with its furniture and fittings, the street, town, or rural scene that we encounter daily, by their incessant iteration, cohere into abiding recollections; and any one part easily brings all the rest into the view. These familiar haunts exemplify pictorial adhesion in a high degree; numerous repetitions and lively interest combine to the result. We likewise associate a number of human beings with their abodes, dresses, avocations, and all other constant accompaniments.

Objects at a distance from our daily circle afford a better opportunity of testing the natural adhesiveness of the mind for pictorial expanse. A house we have visited only once or twice, a strange street, a new scene, puts to the proof the visual persistence of the mind. This resolves itself partly into the case of coloured impressions, and partly into that of visual forms, the tenacity for colour being the essential point. A coloured decoration is quite irrecoverable, if the sense of colour is not very powerful; the same may be said of a heterogeneous and formless collection of ornaments or curiosities. The recollection of dresses turns principally upon the hold we have of colour. The interior of a room implies form, and may be retained as such; but if the sense of colour is indifferent, it will be revived only in outline. A garden, a shrubbery, an array of fields, also rely upon the coloured element. The more irregular the outlines of things are, the more do we depend upon the tenacity of the mind for coloured impressions.

Thus, for the easy retention of the variegated imagery of the world about us in all its richness, the first requisite is a powerful adhesiveness as regards colour. This gives to the mind a pictorial character, an attraction for the concrete of nature, with all the interest thence arising. We have just seen how far it belongs to the naturalist; it is also the common basis of character in the Painter and Poet; for although both these have to select, from the multitude of appearances, such of them as have an interest in art, yet they should be constituted to keep a hold of anything that presents itself to the eye, whether beautiful or not. A luxuriant imagination implies the facility of retaining scenes of every description; nothing less could sustain the flow of a great poet. All objects may not be beautiful or picturesque, yet there is hardly any appearance but may enter effectively into some composition; and the poet-painter needs to be a person of strong disinterested retentiveness for everything that he sees. Any one stopping short at this point would be a naturalist simply; but when the poetic sense is added to lay a special stress upon the beautiful, grand, or touching objects, the naturalist passes into the artist. A strong artistic sense, without the broad disinterested hold of nature's concretes in general, may make a man a genuine or even an exquisite artist, but thin and meagre in his conceptions—great taste with feeble invention.

It appears, then, that in respect of cohesiveness, the habitual conjunctions of objects differ but little from the individual concretes. The retentiveness of the sense of Sight is the mainstay of both the one and the other; in the smaller and more accessible objects we bring in touch and other senses; in the sphere of the large and the remote, we embody the images in sight alone.

56. Among the important aggregates implied under the present head, I may include those artificial representations intended to aid the conception of the outer world, as for example, Maps, Diagrams, and Pictorial Sketches. A very great utility is served by these devices, and much intellectual

power and practical skill depend on our being able to associate and retain them. The Geography of the globe is summed up in an artificial globe, or in a set of maps, with outline, shade, and colour, to correspond with the differences of sea and land, mountain and plain. There are very great differences among individuals in remembering a map. A good adhesiveness for colour is still an important element, just as in the recollection of the actual surface of a country. It is a case of that facile retentiveness of a great multitude of impressions, that contrasts with the severe hold of a few selected ones; an extensive rather than an intensive grasp. Next to maps, we may reckon Natural History sketches, which contain a great variety of appearance depending much upon differences of colour. Anatomical diagrams and the drawings of machinery are of the same nature, but incline to the diagrams of abstract science, where attention is strongly concentrated on few and limited features. When we come to the figures of Euclid, colour entirely disappears as an element; the pictorial retentiveness is of no avail. Form is everything, and that Form is not various, but limited, and exceedingly important. This illustrates, by contrast, the power of seizing nature's aggregates and concretes, where thousands of distinct impressions must fall into their places and cohere with ease, and in a short time. A crowded theatre and the forty-seventh of Euclid are equally objects to the eye, and also to the conceiving mind when they are gone; but the region of the brain that determines the adhesiveness must be quite different in the two cases; in the one, we have colour and variegated form, in the other, a few regular forms with negation of colour.

57. There is an interesting class of artificial conjunctions, wherein the obvious appearances of things are associated with other appearances brought out by Manipulation and Experiment. The properties of a Mineral—the complete notion that we can attain respecting it—are a combination of the sight and the touch with the artificial aspects made by a process of measuring angles, a fracture, a scratch, the blowpipe,

the application of an acid. A complex impression is thus stamped on the mind; at an after time, any one of the characteristic properties will revive the total conception of the mineral. So in Chemistry, each substance is conceived, not simply as seen and handled by itself, but as acted on by many other substances, by changes of temperature, and so forth. The chemist's notion of sulphur is a large aggregate of appearances and sensations produced in various ways; it is, in fact, the notion of a great collection of substances—the compounds of sulphur—as odour of burnt brimstone, oil of vitriol, salts of sulphuric acid, compounds of sulphur with metals, &c. In like manner, the properties of a plant are not completely summed up and aggregated in the mind, till, in addition to all the aspects it presents by itself, other aspects are taken along with it, brought out by dissection and manipulation. This is an exact parallel to an example occurring under the immediately preceding head, namely, tools and machinery, where the present aspect has to be conjoined with other appearances, shown when they are put to their practical uses.

In these mineral and chemical aggregates, there is great scope for proving the force of contiguous association, but still more for testing the disposition to dwell upon *artificial* combinations, the results of previous analysis or forced separation of natural conjunctions. Science, as I shall afterwards have occasion to illustrate, is repellent to the natural mind, from the necessity of *disassociating* appearances that go naturally and easily together, of renouncing the full and total aspect of an object whereby it engages agreeably the various senses, and of resting upon some feature that has no interest to the common eye. Those compounds of sulphur that have to be conjoined with the simple substance as a part of its idea, are constantly viewed by the chemist under the one aspect of composition or decomposition in the contact with other bodies; the appearance of any single substance to the eye may be wholly irrelevant to any purpose of his.

SUCCESSIONS.

58. If we except complex and coinciding muscular movements, and the concurrence of sensations through different senses at the same moment, all associations are successive to the mind, seeing that we must pass from the one to the other, both in the original experience and in the subsequent recollection. The features of a landscape can be conceived only by successive movements of the mind, as it can be seen only by successive movements of the eye. But we here contrast, with the uniform successions that result in the Simultaneous, the variations or changed aspects of things, called Successions proper.

We may notice first the successions that go round in a *cycle*, without shock or interruption, as day and night, the phases of the moon, the course of the seasons. The different aspects presented by the sky above and the world around, in the course of the solar day, are associated in our minds in their regular order, and anticipated accordingly. This cyclical association makes up one part of our knowledge, or experience of the world, and guides our actions in accordance with it. Such slow and tranquil changes become coherent under almost the very same conditions as the aspects of still life that we view in succession by moving from place to place. The two cases are very different in themselves, but to the mind the contemporaneous in reality is the successive in idea. The flow of *moving* nature is associated in one constant direction; whereas the mental association of *still* nature is backward and forward in various directions: yet the same mental adhesiveness that embraces the one, embraces the other.

A second class is comprised by successions of *evolution*; as the development of a plant, or an animal, through all its stages, from the germ to the decadence. The associations of of these, as they occur in nature, make up our knowledge of the history of living things. The peculiarity of the case is the continuity and identity of the main subject, and the likeness that prevails in the midst of change: both circumstances assisting to impress the different stages upon the recollection. If we have already formed an enduring picture of a fir sapling, we have not much difficulty in conceiving the same merely expanded in dimensions, the form and texture remaining the same; and so with any other plant or animal. Where a creature undergoes a radical transformation, as a butterfly, or a frog, we have to conjoin two different appearances. In reality, the stages of evolution are more frequently learned by seeing them altogether on different subjects, as in a plantation of trees, or in the mixture of all ages in human society. The evolution of living beings, plants, or animals, in their growth and decay, usually excites a strong and interested attention, which operates in fixing the successive stages in the recollection. The same happens in historical evolutions, and it is particularly aimed at in the artificial evolutions of the drama and the romance. There is also a strong interest attached to the successive stages of a constructive operation, a process in the arts, a case in a court of law, or the course of a disease. A mind naturally adhesive to sensible impressions would, as a matter of course, acquire, out of its opportunities of observation, a large store of these successions; but the bent of interest concentrating the mind upon some, in preference to others, is the efficient circumstance. One man is engrossed with the progress of the field and the garden, from the seed to the fruit; another looks with especial eye to the human development in body or in mind. The widely-diffused romantic interest stamps with ease the successions of a plot or story.

Apart from this circumstance of special interest in the unwinding of the future, the associations of evolution are not materially different from the conjunctions of still life, these being also unavoidably successive. The pages of a book, or the houses of a street, exist contemporaneously, but cannot be viewed otherwise than successively. The mind formed to associate with little repetition the flowers of the same garden-plot, can likewise retain the different phases of the growing plant.

59. Relating to the recovery of trains of imagery, there is a fact of the nervous system to be attended to; namely, that a mental movement once set on tends to persevere and feed itself. We can remark in the eye a tendency to continue in any motion when commenced, as in following a projectile, or in sweeping round the sky line that bounds a prospect. The spontaneous vigour of the moving organs carries them forward in any direction that they may chance to enter on; and, in addition to the spontaneity of the active system, the stimulus of the sensation itself operates in sustaining a movement that has been commenced. Thus it is, that the eye so naturally follows out a vista, or traces the course of a stream. Seeing the beginning of a straight line, or a part of a circle, we feel ourselves led on to the conception of other parts hidden from the view. A tall spire carries the regards upwards far into the heights beyond itself, while a descending current gives a downward direction to the bodily or the mental eye. Just as we acquire an almost mechanical persistence in walking, or in handling a tool, when once under way, so the sight falls into a given movement, and goes on of its own accord, over the course that has been chalked out for it. When our eye sweeps along the line of a procession, it acquires such a persevering tendency that it is apt to go beyond the termination until its view in that direction is completely exhausted. When a succession of objects is very rapid, as in a railway train, it sometimes impresses a diseased persistency on the visual circles, and we feel everything about us still in motion. Like all the other actions of the brain, this persistency has a moderate and healthy pace, which easily subsides, and a hurried and diseased pace that we cannot check without great difficulty.

Now, in the operation of recalling the steps or members of a succession at the prompting of those that go before, our recollection is aided by the tendency to go forward, or to leap from the one at present in the view, to the next in order. This restless forward impulse, will not suffice of itself to recall the next member without an adequate adhesive growth between it and the preceding, but it counts for something in the act of recovering any object that we are in want of in that particular train. It determines very much the degree of rapidity of the mental action; and from this circumstance gives a marked character to the individual. It does not confer intellectual power—this depends on the proper forces of the intellect—but it favours promptness and quickness in perceiving whatever it is within our power to perceive, a quality often useful in the emergencies of life.

60. The successions designated as *cause and effect*, are fixed in the mind by Contiguity. The simplest example is where our own activity is a cause. We strike a blow, and there come a noise and a fracture. The voluntary energy put forth in the act, becomes thenceforth associated with the sound and the breakage. Hardly any bond of association arrives sooner at maturity, than the bond between our own actions and the sensible effects that follow from them. There are circumstances favouring the concentration of the mind upon this particular sequence.

In the first place, these effects are often themselves energetic, startling, and impressive. This is indicated by the employment of the word 'effect' to mean what yields a startling sensation, something that takes the mind by storm. The stronger kinds are such as produce some startling change in the still routine of things. The firing of a cannon in the quiet of the night; the shattering of a window; the upsetting of a table covered with crockery; the kindling of a conflagration; the taking away of a life,—are all intensely exciting to the nervous system; and the excitement engrosses the mind. One single occasion is sufficient to connect for ever one of these startling events with its immediate antecedent or cause. According as the effects are milder in their character, and slower in their operation, their connexion with the causes is less speedily engrained in the mind. But as a general rule, causation, when distinctly apparent,—that is, when the two or more members of the succession are clearly ascertained and contemplated by the mind,—impresses itself much more strongly than the successions of things in a sweep of landscape, or the stages of vegetable or animal life. There is in man a natural liking for effects, owing to the mental stimulus they give; and much of the pleasure of life is made up of this kind of excitement.

But we must remark, in the second place, that the active impulses of the human mind, which are in many instances the causes of the effects we see, and are assumed as the type of all other causes, are readily impressed on the recollection ; that is to say, it is easy to recall the notion of any action of ours that has been concerned in producing a startling change. Our moving members being always with us, their movements are the most familiar facts that we possess ; we can easily remember a kick, a wrench, or any other common action. Hence, in a succession of two steps, one a familiar action of our own, the other a striking effect on our senses, the first is already formed into a permanent idea by repetition, the second arrests attention ; the fixing of the two is therefore comparatively rapid and sure. Unfamiliar actions as causes are not readily remembered; intricate constructions and mechanism do not impress themselves without due repetition.

In imagining the causes of unknown effects, human power is the first thing suggested, from the facility the mind has of entering into this cause, and also from the pleasure derived by the very idea of human energy put forth in the accomplishment of effects. Hence the universal disposition to personify the powers of nature.

61. The *action and reaction of one man on another* is a notable example of cause and effect, under circumstances favourable to recollection. In this instance, both the cause and the effect are human manifestations, readily conceivable from the fact that we ourselves have been frequently actuated in the same way. When we witness, for example, an encounter of hostility, both the provocation and the retort are actions that we can completely realize from our own past experience. Here, too, as in the cases above noted, the rousing of a human being from quiescence to animation, is a startling effect, and arrests and impresses the beholder. Most persons are susceptible to the view of these sudden changes in the expression of living beings, which constitute a great part of our interest in society and in the drama. By noting those various movements of expression, in connexion with the causes of them,

we become impressed with innumerable sequences of cause and effect; and the recollections thus formed make up a large portion of our knowledge of the ways and characters of mankind.

Some minds are peculiarly susceptible to this class of effects; the movements that constitute the expression of men and animals take a deep hold of their attention, and are proportionably impressed on the memory. Such minds are thereby rendered more than usually knowing in human nature; while at the same time they feel a lively interest in the manifestations of living creatures.

62. Our impression of any individual man or woman is made up of their permanent image, and their various movements and activity, in a number of situations and circumstances. Thus, we have seen some one made angry; we connect the occurrence with the experience of anger in our own minds, and this connexion is an item of our knowledge of that person's character. When the anger is brought before our view, we are reminded of the cause; when the provocation is present, it recalls the anger. We can use the knowledge of this sequence for the purpose of either avoiding or bringing on the effect; we can reproduce it dramatically; we can generalize it as a fact of human nature in general; we can explain other men's anger by it. Other sequences are noted in like manner; and, by sufficient length of time and opportunity, we can associate together cause and effect through the whole cycle of an individual's ordinary actions. We are then said to know the person's character. Our knowledge of animals is of the same nature.

The peculiar susceptibility to the human presence now spoken of may arise out of several different sources. (1.) To the natural history mind all visible imagery is impressive, the human face and form among the rest. (2.) The susceptibility to visible movements is a distinct element, and with it is connected the sense of forms, and particularly the human. (3.) The sympathetic disposition, as contrasted with the egotistic, or self-engrossed, is in favour of the same turn for noticing other people's ways. (4.) The artistic sense finds much of its material in the human subject, and is thereby made alive to the manifestations of living men. To all these causes of special attention to the phenomena of humanity, we are to add (5) the strong passions and emotions that have our fellow beings for their subjects ; and we then see how it comes that the natural, if not 'the proper study of mankind is man.' The interest of external nature viewed by itself is cold in comparison ; hence its sequences makes a much smaller part of the acquired ideas of causation in the generality of minds, than those relating to living men and women.

In the foregoing view, there has been no express mention of *scientific* causation.

MECHANICAL ACQUISITIONS.

We have now touched on the chief fundamental classes of associated things under Contiguity. What remains, is to carry out the illustration into the several departments of intellectual acquirement.

63. Under Mechanical Acquisitions, we include the whole of handicraft industry and skill, as well as the use of the bodily members in the more obvious and universal actions of daily life. Military training ; the exercises of sport, recreation, and amusement ; the handling of tools in every kind of manual operation ; the care of the person,—are all so many acquired or artificial linkings of action with action, or action with sensation, through the operation of contiguous adhesiveness.

The first element of Mechanical Acquisitions concerns the quality of the active instrument—*the muscles.* All the circumstances formerly described (p. 335) as special to the association of movements—Muscular Strength, Spontaneity, and Delicacy of Discrimination—co-operate in promoting our muscular acquirements.

The next thing to be taken into account is the delicacy of the *senses* concerned in the work produced. If the operation is to make a paste, or bring out a polish, Touch is the testing organ, and must have the requisite delicacy ; if the work is judged by colour, the Eye must be duly sensitive ; if to play on an instrument, the Ear must discriminate the shades of sound. However flexible and powerful be the active instrument, it can never transcend the feeling of the effect produced. The most delicate fingers are useless for musical performance, when the ear is wanting in a corresponding delicacy of musical perception.*

Thirdly, we need to estimate the *motives to concentrated attention* ; of these, the chief is a taste, interest, or liking for the occupation itself; and next in order must be ranked an agreeable end to be gained by means of it. The special fascination for handicraft industry, manifested in some constitutions, is a mixed feeling. Part of it, however,—perhaps the largest part—comes from the muscular and sensitive endowments themselves; when these are of a high order there is apt to be an accompanying charm in their exercise. The mere possession of the elements of skill—the hand and the sense—makes it a pleasure to exercise them ; this is not merely from the distinction of superiority (a motive of no mean force), but also from the concurrence of a certain amount of feeling with every considerable endowment. If we have a powerful and flexible active organ, we are gratified by its exercise. In like manner, as to the sense concerned, we cannot have a nice ear for musical pitch, such as would favour musical acquirements, without being susceptible to the pleasure of music ; and the same is true of colour.

* As regards many kinds of mechanical manipulation, the muscular sensibility counts twice, being a property of the organ, and also a property of the sense. Thus, in handling a dough, or tightening a string, the sense concerned is muscular, and the nice graduation of the arm and hand to suit the desired effect is also a muscular discrimination. Hence manual tact, or skill in working with tools or instruments, is doubly dependent on the muscular endowment. Even where the effect is judged, not tactually, or so as to bring in the sense of resistance, but by the eye, the ear, or the taste, the flexibility and measured graduation of the active organ involves the discriminative feeling of expended power, which attaches to the muscular system, and is no doubt unequally manifested in different constitutions.

The more general feelings of the mind, involved in mechanical aptitude, are the pleasure of Power in producing effects, and the satisfaction of the wants and desires that are the final end of industrial occupation. Apart from the motives of subsistence and gain, there is in many individuals a considerable degree of interest in mechanical operations, attributable to the possession of the main aptitudes for the work. Gardening, carpentry, carving, and other mechanical arts, are adopted among the recreations of leisure hours, no less than music. Louis the Sixteenth's lock-making has a place in history.

64. We must now advert to the circumstances aiding in mechanical acquisition, that depend not on the inborn peculiarities, but on the manner of going to work. This is the practical point. In the army, the recruits are drilled three times a day—morning, forenoon, and afternoon, for about an hour and a half or two hours each time. They have thus a meal and a period of rest between each drilling. The main points to be attended to are these :—In the first place, the moments of greatest bodily vigour and freshness are to be selected. In the next place, the exercise ought not to be continued too long at a time; when the muscles and brain are once thoroughly fatigued, the plasticity is at an end; nothing is gained by persisting farther. Lastly, the lessons ought not to be too short : that is to say, a certain time is requisite to get the body into the set that the exercises require. Scarcely any exercise of less than half an hour's duration, will take a decided hold of the system. To hit the mean between the period of thorough engagement of the organs in the work on hand, and the period of excessive fatigue, constitutes the practical judgment of the drill-master in every department. In the army, where the time of the learners is completely under command, the system of three daily lessons with intervals of rest and refreshment is chosen as the best arrangement on the whole; the mental disgust apt to be generated by occupying the entire strength of the system upon one class of operations, is not taken into account.

In the discipline of early education in general, there is more variety of interest, and it is possible to occupy nearly half the day continuously upon the work. But the army system is the model, in circumstances where it is practicable to bring the pupils together, early morning, forenoon, and afternoon.

The rule for the exercises of the learner is very different from the rule for the practised workman at his work. In this last case, long continued and uninterrupted application is best. But in learning a new thing, the stress of the attention very soon fatigues the brain; so does the committing of blunders and false steps. Moreover, the organs unhabituated to an operation are less able to sustain it. When, however, the mechanical routine is perfect, and the parts strengthened by long practice, it is better to continue at work for a number of consecutive hours.

The youth learning a trade keeps the same hours as the workman, and is not treated as an army recruit or a school-boy. In his circumstances the plan of proceeding is different. The apprentice, having gained some one single step, before taking another, goes on repeating that process exactly as a productive workman. His education is spread over a longer time, and is largely diluted with routine work. This makes his situation tolerable during the long hours of the working day. It is when the rate of acquisition is pushed to the uttermost, and actual production is disregarded, that the system of long intervals of rest is most necessary.*

Here, as elsewhere, the learner's progress is vitally dependent on the absence of any other engrossing passion or pursuit. This makes it of so great consequence to have a liking for the subject.

VOCAL OR LINGUAL ACQUISITIONS.

Although the acquisitions of the articulating organs, in speech and languages, follow the very same general laws as

* I should remark, however, that it is unnatural, and on various accounts injudicious, to require an apprentice to work the full time of a fully-trained man.

other mechanical acquirements, their importance as a branch of human intelligence claims for them a special notice. I shall advert first to the vocal exercise of singing.

65. The acquiring of musical airs and harmonies by the voice depends on the Vocal Organs, and on the Ear, aided by certain Sensibilities that may be supposed to pass beyond the ear.

As regards the Vocal Organs themselves, the conditions are those already stated for the muscular aptitudes generally. To the first and second conditions—Vigour and Spontaneity, we must add, if not implied, natural Compass or flexibility. The third condition, the delicate Discrimination of degrees of vocal expenditure, is what most decisively operates in fine execution, as well as being the test of vocal retentiveness.

Next comes the Ear, the regulator of the effects produced by the spontaneity of the Voice. With a view to music, as already noticed, the ear must be discriminatingly sensitive to pitch, and thence to harmonies and discords. This sensitiveness guides the action of the voice, and reduces its wild utterances into regular modes productive of musical effect.

We also take for granted that a discriminative ear will be a retentive ear, so far as the retentiveness depends on the quality of the sense. The enjoyment derived from the art is, as in other cases, a motive to the attention.

The acquisition of Instrumental music may be explained by substituting, for the voice, the action of the hands or the mouth, other things remaining the same.

It would not be difficult to apply a test to the musical adhesiveness of different persons, by fixing upon a corresponding stage of progress, and counting the number of repetitions necessary to learn a melody.

66. In Articulate Speech, we have likewise a case of vocal execution guided by the ear, but with some differences as respects both the action and the feeling. The power of articulating includes a new series of movements, those of the mouth; while the nice graduation of the force of the chest and of the tension of the vocal chords, required in singing, is

here dispensed with. The sensitiveness of the ear to articulate sounds partly agrees with, and partly differs from, the musical sense.

The first stage of speaking is the utterance of simple vowels, or of simple consonants with vowels attached, as *wa, ma, pa, hum.* The sound '*ah*' is the easiest exertion of the mouth; the other vowels, *e, i, o, u,* are more difficult positions. The labial consonants, *m, p, b,* usually, but not always, precede the dental and guttural; the closing of the lips being a very easy effort. The dental letters, *d, l, t, n,* and the gutturals, *k, g,* are perhaps equally easy by nature; the aspirates are more complex and difficult. Of the vibrating sounds, the hissing action of the *s* is sooner arrived at than the *r.* For this last letter *l* and *w* are used, as *lun, wun,* for *run.*

New difficulties appear in the attempts to combine two consonants into one utterance; as in syllables that begin and end with a consonant. Some of these are found easier than others; *mam* is easier than *man,* and this than *mug;* for the reason that it is less difficult to combine two labials, than a labial with a dental, or a guttural. The effect is seen in the word-compounds of all languages.

There are two stages in the acquirement of articulate sounds; the first is the stage of Spontaneous utterances, and the second the stage of Imitation. In both, the natural flexibility or variety of the organs must be coupled with delicacy of the ear for articulate effects, in order to make rapid progress.

The joining of syllables and words into continuous speech brings into play a further exercise of the associating principle.

We must next add the element of Intonation or Cadence. This is among the accessories of musical effect, having little in common with the principal circumstances in Music,—namely, pitch, with its harmonies, and time. In speaking, the voice rises and falls in pitch, but not with any nice or measured gradation; the degrees of stress or emphasis, the alternate rise and fall, the descent and gradual subsidence at the close,—are among the characteristics of cadence, or the music of speech. A great susceptibility to intonation marks some constitutions; when coupled with a flexible articulation, it is the gift of the elocutionist.

The earliest acquisitions of the purely verbal kind—short familiar forms of speech, prayers, rhymes, and stories—are examples of pure verbal adhesiveness. They depend upon the circumstances contributing to verbal memory all through life. If we try to fix the probable order of importance of the several conditions, we shall have to place first the Articulate Ear, and next the Vocal endowment, as regards Articulation; it being a rule of the constitution, for which there is strong presumptive evidence, that the sensitive side of the cerebral organization is more receptive and retentive than the active side. The general conditions of Retentiveness are assumed as usual. The condition of good Adhesiveness on the whole is especially demanded in verbal memory, for reasons already recounted. The motives to Concentration are numerous and various; but they relate principally to the subject-matter, which will be adverted to in next paragraph. Apart from the matter, there may be a great liking or enjoyment of articulate exercises; for this, the chief foundation would be the same high development of voice and of ear, rendering them adhesive without regard to the concentrated attention.

In remembering long poems, as in the case of the ancient bards (not the composers), in the kind of erudition ascribed to the Druids, in the power that some persons have of recollecting long speeches by rote, and in great lingual acquisitions generally, we have examples of the mere verbal memory. It must also enter as an element into high literary power of every kind. In estimating the genius of Shakespeare, we should have to begin by assigning him a very large share of this purely verbal aptitude.

67. The acquisition of the Mother Tongue supposes not merely the cohesion of strings of words heard and uttered, but also the association of names with things, or meanings. We associate the names—fire, table, John, with the objects themselves. We farther associate groups of words,—whole

sentences and trains of sentences, with objects, situations, actions, purposes, feelings, and so on. This refers us back to the law of heterogeneous association (§ 32) whereby the adhesion between two things is ruled by the respective tenacity or persistence of each; the strong pictorial mind, for example, being disposed to remember better the names of visible objects. Whatever contributes to the interest or impressiveness of the subject-matter increases the facility of remembering the names. The strain of diction is thus a clue to the things that have engaged and arrested the mind. Swift could have acquired the magniloquence of Milton, and Milton might have made himself thoroughly familiar (as he was, in some degree, in his prose) with the coarseness of Swift, so far as concerned mere verbal acquisition; but their vocabularies were made up under their respective preferences for the subject-matter.

Written Language introduces the adhesiveness of the eye for Forms, a very powerful adjunct in verbal memory: being an important aid in the mother tongue, and a principal bond of adhesion in the scholarly recollection of languages.

68. In acquiring Foreign Languages by the usual methods, we have more of the purely verbal associations than in the mother tongue. We do not usually connect the names of a foreign language with the objects, but with the names already learnt. We may connect sound with sound, as when we are taught orally, articulation with articulation, or mark with mark in the eye. Thus 'domus' and 'house' may be associated as two sounds, two articulations, or two sights; usually we have the help of all three ways of linking. If we include the act of writing down words, which embodies them also in the nerve centres of the arm and hand (besides concentrating the eye), there are no less than four lines of adhesion, involving two senses and two modes of mechanical exertion.

In the absence of a good contiguous adhesiveness for indifferent objects, such as arbitrary sounds and symbols, lingual acquisitions are necessarily laborious and difficult.

69. Oratorical Acquisition introduces the element of

Cadence. This is partly created in ourselves by the spontaneous flow of voice becoming modified to please each person's own ear; by which means we have *originality* of cadence, whether the quality of the creation be high or low. But for the most part, it is acquired by hearing others, like vocal melodies. Many forms of cadence prevail in human speech. Each nation has characteristic strains of this kind; the foreigner, however perfect in the pronunciation of the words of another language, is detected by the absence of the national manner in his spoken melody. Provinces differ in the same country: English, Irish, and Scotch have their peculiar strains. The orator is a man able to produce a great variety of the richest cadences, just as a singer has the command of many vocal melodies. To fit articulate language into the forms and falls of musical articulation is the orator's art. We have no artificial means of expressing or representing the oratorical rhythm, so as to preserve the manner of a great orator, or to mark the differences between one cadence and another; the notation of the elocution manuals is not carried far enough for that. But we can readily specify the general conditions of oratorical acquirement. The abundant and various action of the voice by primitive constitution, the susceptible ear, the opportunity of hearing many and good varieties of the elocutionist's displays, and a strong sustaining interest in this particular effect, are the essentials; a good general adhesiveness concurring.

Cadence, although properly a spoken effect, is transparent through written composition. In pronouncing the language of Johnson or of Milton, we fall into a distinct strain; this, too, we can acquire and impress upon compositions of our own. We naturally drink in such cadences as are most suitable to the natural march of our own vocal organs, and such as possess the greatest charm.

The Metrical form of language imparts a special pleasure to the ear; and some minds being highly susceptible to it, are disposed to remember by preference composition in verse. Pope 'lisped in numbers, for the numbers came.'

RETENTIVENESS IN SCIENCE.

70. By science, I here understand the artificial symbolism and machinery, requisite for expressing the laws and properties of the world, as distinguished from the actual appearances of things to the common eye, of which I have already spoken under the heads of natural conjunctions, successions, &c. Thus, a treatise on Astronomy is a mass of algebraical calculations and numerical tables. Nothing can well be more unlike the aspects of sun, moon, and planets, than the formulæ and tables expressing the scientific relations of these bodies.

The OBJECT sciences range from the extremely abstract and symbolical, such as Mathematics, where nature in its obvious guise is utterly excluded, to the more concrete subjects of Natural History, wherein some part at least of the acquisition consists in storing up the common appearances of animals, plants, and minerals. The conditions of the acquirement differ, according as any branch is nearer the one or the other extreme. Thus, theoretical Mechanics, Astronomy, and Optics, come under the mathematical class. The experimental parts of Chemistry, Physiology, and Anatomy approach the other end of the scale: in these, the adhesiveness of the natural history mind for sensible appearances and properties, is of the highest consequence.

To advert to the more *abstract* sciences, which represent science as most opposed to our unscientific images and notions of the things about us:—the symbols of Arithmetic and Mathematics in general, the symbols and nomenclature of Chemistry (combining proportions, atoms, &c.), the nomenclature and abstractions of Physiology (cells, corpuscles, ultimate fibres, secreting glands), require a peculiar cast of intellect for their acquisition; and they are so far of a piece that the mental adhesiveness suited for one would not be much at fault in any other. They are a collection of bare forms not remarkably numerous, which are to be held in the mind with great tenacity, and to be accepted as the sole representatives of the phenomena. The self-denial that enables us to dwell among algebraical symbols, concentrating the force of the brain upon them, to the exclusion of all those things that gratify the various senses and emotions,—this abnegation, so to speak, of human interest, is the *moral* peculiarity of the mathematician. It is not necessary that the mathematical mind should be entirely destitute of attraction for colour and beauty, and picturesqueness, and music, but it is necessary for such a mind to cast all these out of the view, and to grapple with the artificial symbols that express the important truths of the world. The interest in attaining the sure and certain laws of the universe, is the motive for immersing the mind in such a cheerless labyrinth of uncouth characters; this motive being once strong in an individual, the other chief requisite is great natural adhesiveness for arbitrary symbols, an adhesiveness that, if depending on local causes, results, in a considerable measure, from the moderate degree of the competing sensibility of the eye—the feeling of Colour. The symbols of a science are few in comparison with the words of a language, but the hold of the one must be much more severe than of the other. A circle used as a diagram in Euclid, must make a deeper impression than a circle as an alphabetic letter. With Euclid's circle has to be associated innumerable lines and constructions, which can never be all presented to the eye at one time, but must be firmly held in idea alone, ready to be brought up on the hint being given; to the alphabetical circle there is no such array of ideal appendages; it is conceived simply as it can be written, and only as regards its visible difference from the other letters of the same alphabet. It is this complication of visible figures, with a multitude of associates not possible to exhibit at once to the eye, and which yet must all be at command, that gives such an intellectual character to scientific reasonings. The Geometrician must retain, in connexion with a circle, all the constructions of Euclid's Third Book, and, if need be, all the constructions that precede and give foundation to these, and likewise the language that represents in words what cannot be presented to the eye; all which puts to a severe test the cerebral adhesiveness for uninteresting forms. Moreover, this adhesion must rapidly get firm at every step, otherwise the earlier steps of a deduction would be lost before the later were fixed. In an algebraical problem, where x is put for one thing, and y for another, the learner must, by the force of a single repetition, remember all through that these letters stand for such and such things. Persons not rapidly impressed with these arbitrary connexions, are unqualified for mathematics.

In Arithmetic, the ciphers, their additions, subtractions, multiplications, and the decimal system of reckoning, are of the nature of associations of symbolical forms, and require the firm concentration of the mind upon arbitrary signs for the sake of the end they serve. In Algebra, the same operation is carried to a higher complexity, but without any difference in the nature of the machinery. In Geometry, a host of definitions have to be remembered; that is, a line, a space, a square, a circle, must be associated with certain other lines and constructions, with the assistance of language. 'A circle is a line equally distant from a central point.' The association here is between the visible aspect of the circle, with its central point, and a line drawn from the centre to the circumference, which line is a representative line, and may be drawn anywhere round the whole compass of the figure. This principle of representation is a thing of the intellect entirely; for, in addition to the sensible object, there is a fact, or a multitude of facts, that cannot be made apparent to the eye at one and the same moment.

In the *experimental* and *concrete* sciences—as Heat, Electricity, Chemistry, Anatomy, and Natural History in general—the consideration of the actual appearances to the senses, mixes largely with the artificial symbols and abstractions, and hence the value of a good adhesiveness for colour and shape, for touch, and even for taste and smell, in storing up the objects of those sciences. The Mathematical mind may be quite at fault here, just as the Natural History mind is apt to be unsuited for the mathematical group of subjects. In Anatomy, for example, there is a vast detail of bones, ligaments, muscles, blood vessels, nerves, &c., and the visual adhesiveness for mere colour is an element in the recollection, as with a map, or a pictorial landscape. The tactual adhesiveness is of some value in this class of objects, and in the various objects of the natural history class—minerals, plants, and animals, all which are handled as well as seen. Thus it is that there are, for the OBJECT sciences, two classes of scientific minds, represented by the extreme terms, Mathematics and Natural History—the abstract or artificial, and the concrete or real. As regards the modes of human interest or fascination, a greater number of classes could be made out: pure mathematics, as in Algebra and Geometry, would have a different set of votaries from mathematics applied in Mechanics, Astronomy, Optics, &c.; and the natural history group would be both separated from experimental Physics and Chemistry, and broken up into its component members, Mineralogy, Geology, Botany, and Zoology.

71. In the next place, as regards the SUBJECT world, we have one comprehensive science, termed Mind, Mental Science, Mental Philosophy, Psychology, &c.

Although the science of mind comprehends many phenomena of an object character, namely, all the outward or observed accompaniments of mind, and all the outward displays of human action, thought, and feeling, it is nevertheless essentially based on the consciousness possessed by each of our own mental states. The taking cognizance of the facts of our own mind, as phenomena to be known and studied, is one of the meanings of the name 'consciousness.' A better designation is self-consciousness, or the power of introspection. Locke applies the name 'Reflection' to this operation; it has also been called the Internal Sense, because it is, to the *subject* world, what the External Senses are to the *object* world.

There is, in some individuals, a special aptitude for this department of knowledge. An abundant recollection of subject states—of feelings and ideas considered as to their mental sequences—is necessary to the mental philosopher, and is of value to all persons requiring a knowledge of mind for their respective vocations ; among whom we may instance the Poet, the Historian, the Orator, the Politician, the Teacher, the Preacher. It is no easy matter to lay down the precise intellectual conditions of the special retentiveness for the phenomena of mind. We have not here the advantage of a distinct organ to appeal to, as with the pictorial memory, or the musical memory ; and yet it is an indisputable fact, that feelings and the successions of ideas, considered as knowledge, are better discriminated, identified, and remembered by some men than by others.

A good general adhesiveness, coupled with a motive to concentrated attention on the laws of mind, would obviously go a considerable way. But if we are farther to inquire into the circumstances that confer a select and special power of retaining subject states in the memory, like the susceptibility to colour applied to the recollection of visible images, we have only *negative* conditions to appeal to. Given a certain plastic energy of the mind, that energy will be directed, either upon the object world, or upon the subject, or upon both, in varying proportions. If there be an almost exclusive bent towards the outward, there will be the minimum of attention paid to the inner world of the subjective consciousness. If the outer world attracts us in only a moderate degree, there will be large surplus of force available for the other. Now, it is not difficult to assign the forces and dispositions that constitute our Object regards. They follow strictly the object side of our being, namely, movement in the first instance, and, in the next, those sensations that, by connecting themselves closely with movement, are looked upon as object properties.

Perhaps the foremost circumstance inclining to the objective point of view is a great endowment for muscular action in all its forms. In some minds, the forces of the system are profusely inclined towards bodily movement and activity.

This induces a preponderating object attitude, and a correspondingly reduced subject attitude. A certain share of subject existence must fall to every sentient being: pleasure and pain must always be recognized and acted on. But the subject existence may amount to little beyond pleasure and pain, as motives to the will. That further tendency, of making these a matter for study and reflection, will be prevented by the intense proneness to bodily movement. When the outward prompting is less than ordinary, the purely subject existence occupies a larger space; the feelings and ideas, being more attended to, are better known and remembered.

It is well known that when bodily vigour is high, and the disposition to exert it correspondingly great, self-consciousness in all its forms is at a low ebb. Obversely advancing years, sickness, and confinement of the energies—throw the mind upon itself and bring forth the points of introspective regard, in the shape of greater knowledge of the human feelings, more sympathy with others, a moralizing tendency, and ethical self-examination.

Next to the disposition towards bodily energy, we must rank, as anti-subjective tendencies, the sensations of the leading object senses, as Sight, Hearing, and Touch. A strong sensibility to colour, to form, or to articulate utterance, operates in the direction of object regards; if those sensibilities are only average, or below average, in a mind of great compass, a large share of attention will fall upon the subject states. We can never extinguish the object regards; they might even be too low for the purposes of mental study; the mind must exemplify its powers by working in the object attitude, in order that we may study these powers.

The subjective mind is more than usually alive to its *organic* states, which have very little object reference. These feelings direct us at most to the body itself, which is no doubt an object, as being a part of the extended; but, in contemplating it, we are not led out of self in the same decided manner as in viewing other objects. Indeed, by fixing the gaze on our own sensitive parts, we may produce a new subject sensibility, owing to the associations that connect them so strongly with our feelings.*

BUSINESS, OR PRACTICAL LIFE.

72. In the higher departments of industry, or business—handicraft labour being the inferior department—the forces of the intelligence have a wide scope, the widest next to pure science. In the formalities and machinery of business,—book-keeping, calculation, money-reckoning, banking, contracts, deeds, acts of parliament, &c.—we have a number of dry artificial elements, not unlike the machinery of the abstract sciences, but touching more closely and frequently upon things of universal interest. In fact, the superior branches of industry,—commerce, manufactures, government, &c.—seem well adapted for the great majority of the cleverest minds. The pains averted, and the gratifications procured, by wealth, are so various and powerful, as to stimulate strongly the mass of human beings; while only a very few can ever be possessed with the love of truth in the abstract, as a dominant sentiment of the mind.

73. The management of human beings, which is a large department of practical life, proceeds partly upon certain active qualities, that give a natural influence and ascendancy

* The tendencies of the mind towards sensation, or the actual, are opposed to two things, both included under one name, Reflection. A person may be given to Reflection, in the meaning of contemplation or meditation, on the matters of the object world. According to this meaning, every man that thinks seriously on anything must practise Reflection. It is by reflecting beforehand that we save ourselves the trouble of actual trials in many instances. The unreflecting and active temperament would prefer the trial. A mathematician, a physiologist, a politician, an engineer, a general, a poet, must reflect a great deal; having a certain acquaintance with the facts of the outer world, they must think over those facts in combining them anew for their several purposes.

The other meaning of Reflection (the meaning in Locke) is the introspective, or self-conscious regards, as now described. Sir W. Hamilton would call it the Presentative Faculty for the knowledge of Self.

over others, and partly upon a knowledge of the ways and tempers of men. Without such knowledge in considerable measure, the master of workmen, the teacher, the legislator, and many other professions besides, can hardly be said to be skilled in their craft. It requires a kind of observation rendered difficult by the very causes that make man interesting to man; for those passionate feelings that arrest our gaze upon our fellows, sway the mind from cool judgments. It is not so easy to read accurately a man or woman, as it is to read a mineral.

A person engaged in any work should naturally be alive to the *end*, for this it is that guides his hand. The builder sees that his wall is rising plumb and square. But in acting upon men in the various capacities of teaching, ruling, persuading, pleasing, serving, we are not so sensitive to the exact result of our attempts as in dealing with the material world, nor so ready to adapt our movements to suit the end in view.

ACQUISITIONS IN THE FINE ARTS.

74. In the Fine Arts, there are produced combinations, aggregates, groupings, rhapsodic successions,—such as to yield the species of effect termed beautiful, sublime, picturesque, harmonious, &c.; and the perception of those effects is Taste.

The artist in any department has to attain the power of producing these combinations. This power is, in the first instance, a result of creative spontaneity, guided by the sense of the effect produced; it is a mode of the natural forth-putting of the energies of the voice, or the hand, as in the commencement of every kind of active faculty. The first musician gave scope to his vocal powers at random, and gradually corrected the action according to his ear. When this natural outburst took some definite and agreeable shape, it became a song, a melody, caught up by imitation and handed down to future ages.

A large part of every artist's power necessarily comes by acquisition, or by the operation of the force of Contiguity. He stores up the combinations produced by previous artists, and fixes in his mind those that he produces in himself, and gradually rises to his highest efforts of execution. In this acquisitive process, the conditions appear to be the following, of which, however, the enunciation is not altogether new to the reader.

(1.) A keen sensibility and adhesiveness for the element or the *material* that the artist works in. The musician's ear must be sensitive to sounds and successions of sound, by which circumstance he is able to acquire a large stock of melodies. The sculptor must have a keen sense of contour and form; the painter, of form and colour; the actor, of dramatic movements; the poet, of language and the usual subjects of poetry.

(2.) In addition to this sensitiveness to the material of the art, we must note the special sensibility to the *proper effects of the art;* the sense of melody and harmony in music, of beautiful curves and proportions in sculpture and architecture, of these last with coloured effects in painting, and so forth. I take for granted that beauty is not arbitrary,—that there are effects that please mankind generally. For these the artist has a marked preference, and, by virtue of such preference, he acquires a stronger hold of what causes them, than of what does not. The poet needs a large disinterested adhesiveness for the concretes of nature and the incidents of humanity, but with this alone he would be indistinguishable from a born naturalist: the disinterested adhesiveness must be qualified by a special fascination for things that have a poet's interest, so as to alter the proportions of his impressibility, and give the preponderance to one special class of appearances. Not all trees, and all mountains, and all vegetation, and all displays of human feeling, should impress alike either a painter or a poet.

(3.) An artist is to a greater or less extent a *mechanical workman,* and improves in his art according as he attains to the requisite mechanical operative skill. The singer, the orator, the actor, must cultivate the voice. The painter and the sculptor are persons that would soon learn any handicraft operation of the artisan's workshop. The poet, however, like the abstract thinker, may dispense with this muscular element of character.

HISTORY AND NARRATIVE.

75. The successions of events and transactions in human life, remembered and related, make History. A considerable portion of each one's stock of recollections is made up of such materials.

The transactions and events wherein we have been ourselves present, impress themselves on the mind as pictures of living men and women, their various manifestations, and the appearances and situations of things about them. It is thus that we retain the impression of a public assembly, a military spectacle, a pageant, a play, or any of the daily ongoings of private society or of ordinary business. The pictorial mind is fully alive and susceptible to such things, and is tested by retaining them. The retentiveness is heightened by the general interest in human beings, and by the specific or personal interest that belongs to the transactions. The soldierly feeling fixes the mind upon battles, reviews, and military movements; the trader is arrested by markets and commercial enterprise; the politician wakens up to diplomatic congresses and debates; the sporting mind is alive on the race-course; the family interest excites the attention upon the incidents of the domestic circle.

A single transaction deliberately witnessed is often able to stamp itself in the memory for life. There seems to be, in the case of human events, an exception to the law of Repetition, or to the usual necessity for passing a thing before the mind many times in order to make it coherent. But we are able to account for the seeming anomaly. For, in the first place, such transactions are usually slow; that is, they keep the attention awake for a length of time before they are completed; a single horse race, if we include the preparations, will engage the mind for an hour together; while some transactions occupy days and months, being the subject of frequent attention all through. But, what is more, many past events are frequently brought to mind; and every such occasion is a mental repetition. After being present at an exciting spectacle, our thoughts keep themselves engaged upon its details; and, in the retrospect, we expand our attention upon things that were but hurriedly glanced at, as they passed before the actual view. Such rehearsal in the mind after the reality has passed, is a great means of impressing the events of our personal experience. The degree of emotional interest attaching to them displays its efficacy in bringing about their more or less frequent recall. What is indifferent passes away, and is never dwelt upon afterwards; what has excited us at the time excites us in the remembrance, and secures a large space in our ideal meditations. Provision is thus made for consolidating in the memory a train of circumstances that do not admit of being repeated in the actuality. We are enabled to recall, in after years, all the leading transactions that are now going on around us; we can describe the incidents connected with our family, our village, our city, our school, our places of business, recreation, or worship; we can live over again in minute detail, the scenes that had an intense pleasurable or painful interest at the time.

76. The transactions that we know by hearsay, or the narrative of others, impress themselves somewhat differently. We have no longer the actual scenes presented to our vision. They are represented by words, and the recollection is modified by the circumstances affecting verbal adhesion. If we make the extreme supposition, that the hearer of a narrative has his mind carried at once to the scenes and events themselves, and is able to realize them with an almost living force, the case is not different from the foregoing; the words are made use of to hoist the scenes, and then drop away. But there are few people that have this vivid power of conceiving the realities of narrated transactions. In general, the verbal

succession of the narrative is itself a medium of holding together the events contained in it, and the recollection is a mixture of adhesions, pictorial and verbal.

Written history may, therefore, be retained by a good verbal memory. Where the thread of pictured events has snapped, the thread of verbal succession in the printed page may suffice ; the power of recollection on the whole is irregularly divided between the two.

OUR PAST LIFE.

77. The train of our Past Existence, as a whole, is made coherent in the mind through contiguity, and can be recalled with more or less minuteness according to the strength of the adhesion. In any subject that is complicated with details, only a few prominent features usually cohere ; as, for example, the striking parts of a landscape, or incidents of a history ; and such is the case with the great complex currents of each one's individual existence.

This current is made up of the elements contained in the foregoing heads of this chapter. It embraces all our actions, all our sensations, emotions, volitions, in the order of their occurrence. It is the track described by each individual through the world during his sojourn therein ; it comprises all that he has done and all that he has been impressed with.

Under the previous head, I have spoken of the stream of history, or the current of events passing before the eyes of a spectator supposed to be passive. But spectatorship of what is going on about us, does not express the whole current of our remembered existence ; there is wanting the series of our own doings and transactions. When what we have *done* is added to what we have *seen* and *felt*, the history of self is complete.

The distinguishing feature of the present case, therefore, is the remembrance of our own actions according as they happened. What is the nature of the bond that cements things done by us, and not simply witnessed ?

78. In the first place, many of our movements consist in

changing the spectacle about us, or in producing a series of appearances to the eye, or of effects on the senses in general. Thus, when we walk out, we bring before our eyes a stream of houses, shops, streets, fields; and the impression of the walk, the coherent trace that it leaves in the brain, is, in part at least, pictorial, just as if we stood still and saw the scenes shifted in the same order. So, our work often consists in producing changes seen and remembered as sensible appearances. The ploughman's active day is partly summed up in the furrowed field that is pictured in his mind in the evening retrospect. Hence remembered actions may be to a great extent remembered appearances; so far, the case now in hand is in no ways different from the preceding.

It is evident, however, that there must be a remembrance of actions by themselves, as well as of the changes that they bring before the view. We do in fact have a recollection of our own active states as such; we can describe the movements made by us, the feelings of pleasant exercise, laborious exertion, or reposing fatigue, that we have successively gone through in a given day, week, or month.

This takes us back to what was laid down, at the commencement of the present chapter, on the Ideas of movement and action. I endeavoured to show that these are formed by re-actuating the circles of movement, but so as to come short of the full stimulus required by the action itself; the remembrance of striking a blow is in reality all but to repeat the act, the restraining of the full display being sometimes a considerable effort. Now, successive actions cohere both as actions and as ideas; we may either perform an action outright, or stop short at the mere idea or vestige of the action. Much of our life is spent in going over remembered and ideal actions; and when we recover a work done by us, merely as a matter of history, and not for the purpose of doing the work again, the vestige, or idea, of the different steps is what passes along the mental tracks. These vestiges of movement executed are as really and truly mental possessions, or ideas, as the remembered pictures of the external world through the eye. We can revive one or other in the ideal form; and, inasmuch as our sensations are all unavoidably mixed up with movements, our recollections are usually a mixture of the two.

Now, in recalling a series of movements, as, for instance, a dance, simply for our own gratification, because of the agreeable feelings that they gave in the reality, we do nothing but revive those vestiges or diminished currents that suffice for the purpose of a recollection. This is to live our history over again in idea. And when we have acquired the power of *naming* all the various movements in succession, the ideas, as they successively repossess the various organs, suggest the names of the different steps, and we can then narrate the whole in language. It is this power of narrating that we usually term the recollection of an event, and that constitutes history. With the power of language that belongs to human beings, it happens that our recollections of what we have gone through, do not occur as pure ideas of the actions and scenes themselves, but as ideas mixed up with verbal descriptions, which last are constantly disposed to intrude themselves into our recollections, even when these are not communicated to any one.

The firm adhesion of the ideas or vestiges of our active movements is a case of muscular contiguity, like the adhesion of the actions themselves in acquiring mechanical habits. I cannot find any other law for the association of ideas of movements than for actual movements. I have already endeavoured to discuss the circumstances favourable to the adhesion of muscular trains, and these would, I conceive, hold in the present case also. People that have a facility in acquiring mechanical habits, would, in general, have an equal facility in remembering the steps of any performance that they had gone through. The greater instance implies the less; the adhesion of the movements in full involves the adhesion of the currents that stop short of movement.

The case is altered, as above remarked, by the intrusion of language or expression; in so far as we rely upon this, our remembrance will be easy or difficult according as our adhesiveness for language is strong or feeble. This is not the only instance of impressions retained by the help of some foreign machinery more adhesive than themselves. We have seen the same thing in the retention of the sensations of the inferior senses.

79. Our past life may, therefore, be conceived as a vast stream of spectacle, action, feeling, volition, desire,—intermingled and complicated in every way, and rendered adherent by its unbroken continuity. It is impossible, however, to associate equally all the details, so as to recover them at pleasure; only the more impressive facts remain strung together in recollection. The larger epochs and the stirring incidents readily come to our recollection, when we go back to some early starting point; while the minor events fail to appear on the simple thread of sequence in time, and are recalled only by the presence of other circumstances that serve to link them with the present. It is our custom, in recalling the past, to string together events in new connexions, as when any one recites the history of their early education, selecting out of the miscellaneous stream the incidents relating to that one point. Our individual history becomes thus broken up into sections and partial narratives; and to recover the total current, we should find it requisite to collect these into one great sequence, upon the thread of strict succession in order of time.

80. I have thus presented a series of examples of the working of the Retentive, or adhesive, property of the Intellect. As the subject proceeds, there will be other opportunities of adding to the illustration. The special branch of Moral acquisitions, or Habits, will best find a place in treating of Volition. There now only remain some general observations on the nature of this great adhesive force.

(1.) Throughout, we have assumed superiority in acquisition to depend partly on general conditions—Repetition, Concentration, and the Adhesiveness of the mind as a whole; and partly on special or local endowments. The only doubtful point is the relative shares of the general adhesiveness, and of the local endowments of the senses and moving organs. There is, certainly, a presumption in favour of a contrast, from the essential difference between sense and intellect, notwithstanding their intimate connexion and dependence. Anatomically the two are thought to be separately embodied; the senses being more related to the ganglia of the brain; the intellect to the convoluted hemispheres.

Besides, there are individuals distinguished as *learners* generally; they may not succeed in all subjects alike, but they have an aptitude for acquirement so extensive as not to be properly referable to endowments of the special senses. When we find a man almost equally accomplished in mechanical art, fine art, language, science, business, we regard the case as coming under general retentiveness, and not under an aggregate of high sense-endowments. Lastly, many of the lower animals, as the dog, have sense-endowments of the first order. If we judge them by the proper test of a sense—delicate discrimination, they will bear comparison with human beings, even in Sight and in Hearing, not to mention their superiority in Smell. But their powers of memory do not correspond; and we must represent the inferiority as attaching to the intellectual region strictly so called, or whatever imparts the retentive power on the whole.

(2.) In the second place, I may advert to the known superiority of early years as regards this force or plasticity. It is impossible to state with any precision the comparative intensity of the adhesive growth at different ages, but there can be no doubt of the fact of its gradually diminishing from infancy to old age. Bodily acquisitions are easiest while the organs are still flexible, apart from the plastic adhesiveness of the brain; hence a maximum age is fixed for admitting recruits into the military service. At the present time, I believe the age of twenty-three is the extreme term of admission. Up to this age, any bodily habit is easily assumed; the moral discipline of obedience is also comparatively easy. But for both the one and the other, the earliest years are the best. We must always take account of the obstruction arising from adverse bents and acquisitions. In matters where the bodily and mental system are not pre-occupied, the age of twenty-five is a very plastic age, as for example, in learning business-forms, languages, or science. On the other hand, the voluntary command of the attention is greatest in mature life.

(3.) We remark, finally, that there is a temporary adhesiveness as distinguished from what is enduring or permanent. I may convey a long message from one room to another, but be unable to reproduce it next day. The endurance of the first impression, while the mind is wholly occupied with it, is no surety for its being retained for a week or a month to come.

The illustration in this chapter has been mainly directed upon the enduring acquisitions. We have generally understood the retainability of an impression to mean the power of recalling it at any future time, however remote. But it is necessary to take account of the tendency of all acquisitions to decay by time; the rate of decay being dependent on various circumstances, and chiefly on the decay of the brain itself. It is observed that the impressions that survive, in extreme old age, are those of early years.

To keep our acquisitions from decaying, it is requisite that they should be occasionally revived. A language acquired in early years may be utterly lost by disuse; whereas, if kept up till mature age, it will be fixed for life. Sustained practice seems particularly necessary in early education: children's acquisitions are very liable to decompose, if not kept up and confirmed by new additions. No precise laws have ever been ascertained in this department of the human mind.

The system of *cramming* is a scheme for making temporary acquisitions, regardless of the endurance of them. Excitable brains, able to command a very great concentration of force upon a subject, will be proportionably impressed for the time being. By drawing upon the strength of the future, we are able to fix temporarily a great variety of impressions, during the exaltation of cerebral power that the excitement gives. The occasion past, the brain must lie idle for a corresponding length of time, while a portion of the excited impressions will gradually perish away. This system is unfavourable to permanent acquisitions; for these, the force of the brain should be carefully husbanded and temperately drawn upon. Every period of undue excitement and feverish susceptibility is fraught with great waste of the plastic energy of the mind on the whole.

CHAPTER II.

AGREEMENT—LAW OF SIMILARITY.

Present Actions, Sensations, Thoughts, or Emotions tend to revive their LIKE among *previous* Impressions, or States.

1. CONTIGUITY joins together things that occur together, or that are, by any circumstance, presented to the mind at *the same time;* as when we associate heat with light, a falling body with a concussion. But, in addition to this link of reproductive connexion, we find that one thing will, by virtue of Similarity, recall another *separated from it in time,* as when a portrait recalls the original.

The second fundamental property of Intellect, termed Consciousness of Agreement, or Similarity, is a great power of mental reproduction, or a means of recovering past mental states. It was noticed by Aristotle as one of the links in the succession of our thoughts.

As regards our *knowledge*, or perception, of things, the consciousness of Agreement is second only to Discrimination, or the consciousness of Difference. When we know a thing, we do so by its differences and its agreements. Our full knowledge of red, is our having contrasted it with all other colours, and our having compared it with itself and with its various shades. Our knowledge of a chair is made up of our experiences of the distinction between it and other articles of furniture, &c., and of the agreement between it and other chairs. Both modes are involved in a complete act of cognition, and nothing else (except, of course, the Retentiveness implied in the one and the other) is necessary. Our knowledge of man is the sum of the points of contrast between a man and all other things, and the sum of the points of identity on comparing men with one another. Our increase in knowledge is constantly proceeding in both directions: we note new differences, and also new agreements, among our experiences, object and subject. We do not begin to be conscious till we have the shock of difference; and we cannot make that analysis of our conscious states, called the recognition of plurality, combination, or complication, till we discover agreements, and refer each part of the impression to its like among our previous impressions. To perceive is, properly, to recognize, or identify.

2. Some preliminary explanation of the kind of relationship subsisting between the two principles of Contiguity and Similarity, is requisite in order to guard against mistakes, and especially to prevent misapprehension, as to the separate existence of the two modes of action in the mental framework. When the cohesive link between any two contiguous actions, or images, is confirmed by a new occurrence or repetition, obviously the present impression must revive the sum total of the past impressions, or reinstate the whole mental condition left on the occasion immediately preceding. Thus, if I am disciplining myself in the act of drawing a round figure with my hand, any one present effort must recall the state of the muscular and nervous action, or the precise bent acquired at the end of the previous effort, while that effort had to reinstate the condition at the end of the one preceding, and so on. It is only in this way that repetition can be of any avail in confirming a physical habit, or in forming an intellectual aggregate. But this reinstatement of a former condition by a present act of the same kind, is really and truly a case of the operation of the associating principle of similarity, or of like recalling like; and we here plainly see, that without such recall, the adhesion of contiguous things would be impossible. Hence it would appear, that all through the exposition of Contiguity, the principle of Similarity has been tacitly assumed; we have everywhere taken for granted, that a present occurrence of any object to the view, recalls the total impression made by all the previous occurrences, and adds its own effect to that total.

But, by thus tacitly assuming the power of anything present to reinstate the past impressions of the same thing, we restrict ourselves to those cases where the reinstatement is sure and certain, in fact to cases of absolute identity of the present and past. Such is the nature of the instances dwelt upon in the previous chapter: in all of them, the new movement, or the new image, was supposed precisely *identical* with the old, and went simply to reinstate and to deepen an impression already made. We must, however, now pass beyond this field of examples, and enter upon a new class where the identity is only partial, and is on that account liable to be missed; where the restoration, instead of being sure, is doubtful; and where, moreover, the reinstatement serves higher purposes than the mere iteration and deepening of the impression already made. In all mental restorations whatsoever, both Contiguity and Similarity are at work; in one class, the question is as to the sufficiency of the contiguous bond, the similarity being sure; in another class, the question is as to the sufficiency of the attractive force of the likeness, the contiguous adhesiveness being believed certain. If I chance to meet with a person I have formerly seen, and endeavour to remember his name, it will depend upon the goodness of a cohesive link whether or not I succeed; there will be no difficulty in my recalling the past impression of his personal appearance through the force of the present impression; but having recalled the full total of the past impressions, I may not be able to recover the *accompaniment* of the name; the contiguity may be at fault, although the similarity works its perfect work of restoring to me my previous conception of the personal aspect. If, on the other hand, I see a man on the street, and if I have formerly seen a portrait of that man, it is a question whether the living reality shall recall the portrait; the doubt hangs not upon the contiguity, or coherence of the parts and surroundings of the picture, if it could be recovered, but upon the chance of its being recovered. Where things are identical, the operation of similarity, in making the present case revive the former ones, is so certain that it is not even mentioned; we talk of the goodness of the cohesive bond between the revived part and its accompaniments, as if contiguity expressed the whole fact of the restoration. To make up for this partiality of view, which was indispensable to a clear exposition, we now embrace, with the like partial and prominent consideration, the element that was left in a latent condition; and allow to sink, into the latent state, the one that has hitherto been made exclusively prominent.*

3. In the perfect identity between a present and a past impression, the past is recovered and fused with the present, instantaneously and surely. So quick and unfaltering is the process that we lose sight of it altogether; we are scarcely made aware of the existence of an associating link of similarity in the chain of sequence. When I look at the full moon, I am instantly impressed with the state arising from all my former impressions of her disc added together; so natural and necessary does this restoration seem, that we rarely reflect on the principle implied in it, namely, the power of the new stimulus to set on the nervous currents, with all the energy acquired in the course of many hundred repetitions of the same visual impetus. But when we pass from perfect to imperfect or partial identity, we are more readily made aware of the existence of this link of attraction between similars, for we find that sometimes the restoration does not take place; cases occur where we fail to be struck with a similitude; the spark does not pass between the new currents and the old dormant ones. The failure in reinstating the old condition by virtue of the present stimulus, is, in the main, ascribable to *imperfect identity*. When, in some new impression of a thing, the original form is muffled, obscured, distorted, disguised, or in any way altered, it is a chance whether or not we identify it; the amount of likeness that remains will have a reviving power, or a

* To a mathematical student this would be made at once intelligible by saying that, in the former chapter, the Contiguity is assumed as the *variable* element, and the Similarity the *constant;* in this chapter, Similarity is supposed variable and Contiguity constant.

certain amount of reinstating energy, but the points of difference or unlikeness will operate to resist the supervention of the old state, and will tend to revive objects like *themselves*. If I hear a musical air that I have been accustomed to, the new impression revives the old as a matter of course; but if the air is played with complex harmonies and accompaniments, it is possible that the effect of these additions may be to check my recognition of the piece; the unlike circumstances may repel the reinstatement of the old experience more powerfully than the remaining likeness attracts it; and I may find in it no identity whatever with an air previously known, or even identify it with something altogether different. If my hold of the essential character of the melody is but feeble, and if I am stunned and confounded with the new accompaniments, there is every likelihood that I shall not experience the restoration of my past hearing of the air intended, and consequently I shall not identify the performance.

4. The obstructives to the revival of the past through similitude, may be classed under the two heads—Faintness and Diversity. There are instances where a new impression is too *feeble* to strike into the old-established track of the same impression, and to make it alive again; as when we are unable to identify the taste of a very weak solution, or to discern an object in twilight dimness. The most numerous and interesting cases come, however, under the other head—Diversity, or mingled likeness and unlikeness; as when we meet an old acquaintance in a new dress, or in circumstances where we have never seen the same person before. The modes of diversity are countless, and incapable of being classified. We might, indeed, include under diversity the other of the two heads, seeing that faintness implies diversity of *degree*, if not of any other circumstance; but I prefer considering the obstruction arising from faintness by itself, after which we shall proceed to the larger field of examples marked by unlikeness in other respects.

5. The difficulty or facility in resuming a past mental

condition, at the suggestion of a present similitude, will plainly depend upon the *hold* that the past impression has acquired; it is much easier to revive a familiar image than an unfamiliar, by the force of a new presentation. We shall, therefore, have to keep this circumstance in view, among others, in the course of our illustration of the law of Similarity.

It has to be considered how far natural character—that is, a primitive endowment of the intellect, enters into the power of reviving similars, or of bringing together like things in spite of the repulsion of unlike accompaniments. There is much to be explained in the preferences shown by different minds, in the objects that they most readily recall to the present view; which preferences determine varieties of character, such as the scientific and the artistic minds. The explanation of these differences was carried up to a certain point under the Law of Contiguity; but, if I am not mistaken, there is still a portion referable to the existence of various modes and degrees of susceptibility to the force of Similarity. From all that I have been able to observe, the two energies of contiguous adhesion, and of attraction of similars, do not rise and fall together in the character; we may have one feeble and the other strong, in all proportions and degrees of adjustment. I believe, moreover, that there is such a thing as an energetic power of recognizing *similarity in general,* and that this is productive of remarkable consequences. Whether I shall be able to impress these convictions upon my readers, will depend upon the success of the detailed exposition of this noted peculiarity of our intellectual nature.

FEEBLENESS OF IMPRESSION.

6. We commence with the case of Faintness, or Feebleness, in the present, or suggesting impression, considered as an obstacle to the revival of the corresponding previous impression. There is, in every instance, a certain degree of feebleness that will disable the present image from falling

into the track left by the same image in its former advent. When an extremely faint influence, in the present, revives the old currents, we must suppose the restoring action of similarity to be unusually vigorous in that mind, or for that class of impressions. Thus, if from a very feeble solution of salt in water, such as occurs in many land springs, the impression on the tongue were sufficient to revive in one person, and not in another, the past state of mind produced by the tasting of salt, we should naturally remark that the one excelled the other in the attractive force of similarity so far as concerned Taste. The superiority, however, admits of being referred to various circumstances. (1.) In the first place, mere natural acuteness of taste, such as is shown in nicety of discrimination, would also show itself in greater readiness to identify a feeble impression. (2.) In the next place, there might be a greater previous familiarity with this particular taste, the consequence of repetition and the other circumstances favouring retentiveness. (3.) Distinct from the last, although apt to concur with it, is the habit of concentrating the attention upon the sense of taste, owing to some special interest or motive. These are three circumstances having a special or local reference, and not implying greater power of Similarity on the whole; but we shall find reason for believing, on grounds analogous to those brought forward in support of a general power of retentiveness, that persons may differ as regards Similarity in general. If so, this is a fourth alternative explanation in the case supposed.

7. Such is an example taken at random, to show what is meant by the revival of impressions under the impediment of feebleness. I might go systematically through the Sensations of the various Senses, to gather illustrations of the same fact. (Movements apart from Sensations hardly furnish cases in point.) In the various sensations of Organic Life, there occur examples of difficult reinstatement, through feebleness of the suggesting sensation. I may experience a certain uneasy sensation, which I cannot describe or identify,

because of its being too faintly marked to reproduce the old accustomed impression of the same thing. It may be a derangement of the stomach, or the liver, or the brain, such as I have experienced before, and possess a durable conception of; but being too little prominent to strike into the old track, it reminds me of nothing, and I cannot tell what it is. By-and-by, it increases somewhat, and becomes powerful enough to reinstate some likeness of it in the past, and I then recognize it. The conditions favourable to the effect are, as above stated, a great acuteness of organic sensibility, previous familiarity, and the habit of attending to organic states; together with the general power of Similarity. A keen organic sensibility may be noted as a peculiarity of some constitutions, making the individual extremely self-conscious, in the acceptation of being alive to every passing change of organic state; generating hypochondria and the alternation of fears and hopes regarding one's bodily welfare. The peculiarity will be occasionally found rising to a morbid extreme; as when the individual never passes an hour without solicitude on the matter of health and mortality. Obtuseness of feeling to what is going on within the various bodily parts is a defect fraught with dangerous neglect; while, on the other hand, a needless amount of distress, and a needless waste of precaution, may be the result of too much sensibility, whether this have its origin in the sense or in the intellect.

8. I have already cited an example from Taste. There would be no material difference in the circumstances of a case of Smell. When a very faint odour is recognized or identified, this shows that, notwithstanding the faintness of the impression, the previous sum total of the same smell has been brought back. If two persons be subjected to a particular odour, as in walking through a garden, and if one detects it while the other does not, the explanation is to be sought, as before, either in the General Power of Similarity, or in one or more of the three Special and Local circumstances—namely, greater natural delicacy or acuteness of the organ,

greater previous familiarity with the odour, and a habit of concentrating attention upon odours in general, or this in particular. Could we ascertain that both persons had an equally acute or delicate nose, we should have to account for the difference by the two other local circumstances—greater previous familiarity, and the habit of attention, or else by the power of Similarity on the whole. If we know that two persons are equal as regards both familiarity with an odour and the habit of attending to it (circumstances tolerably easy to ascertain, and likely to go together), the greater power of identification displayed by one would either prove a special delicacy of the organ, or be referable to Similarity in general.

9. The sense of Touch does not appear to furnish any instructive case of the action of reinstatement made difficult by feebleness of impression, for we can usually command any degree of contact that we please. We may, however, derive examples in point from Hearing. It often happens that sounds are so faint as to be barely discernible, in which case we shall observe one person making them out, and another missing them. The difference of acuteness must be referred, as before, to delicacy of ear, to familiarity, acquired delicacy through the habit of attention, or else to general Similarity. The influence of familiarity, in particular, is well exemplified in sounds. Compare the hearing of our mother tongue with the hearing of a foreign tongue; every one knows how easy it is to catch up an utterance in the one, even when very faintly pronounced, and how we fail in the other under like circumstances. The same contrast is observed between a familiar voice and the voice of a stranger; persons partially deaf identify the speech of those about them, and are unable to understand others speaking at the same pitch. This fact obtains all through the field of associations by similarity; the more thoroughly accustomed the mental system is to an impression, the lighter the touch needed to make it present at any moment.

10. The same line of illustration can be carried out under the Sense of Sight. There is a point of twilight dimness

when objects begin to be doubtful; they fail to reinstate the corresponding previous impressions whereby their identity is made apparent. Haziness in the intervening sky, and mere distance, have the same effect. In those circumstances, we find that an object can be identified by one person, and not by others equally well situated for discerning it. Familiarity, together with professional habits of attention, will in many cases explain the difference, as when a sailor identifies a speck on the horizon as a ship of a particular build. Otherwise, the superiority of one person over another in discernment must be ascribed either to the sensitiveness of the eye, or to the force of similarity in general.

11. In the case of very exalted acuteness of sense, such as we witness among the Indians, who can discern the tread of horses at a great distance by applying the ear to the ground, and who have also a high degree of long-sightedness, we must refer principally to the two circumstances included in the education of the eye—familiarity and habitual concentration. It may be that natural acuteness of sense is hereditary in that state of life; still, practice is undoubtedly the main cause of the remarkable difference in this respect between these savage tribes and the generality of mankind. The education is not simply a frequent repetition of those sensations of the tramp of horses or men on the ear, but the concentration of the brain upon the sense on those occasions, whereby an intense stretch of attention habitually accompanies the act of listening. The degree of voluntary attention given to an observation of sense, will at any time make the sensation more acute; a habit of absorbing attention will generate a permanent acuteness at the expense of attention to other things. A painter will be the more impressed with a landscape that he is deaf to the song of birds, the hum of insects, or the murmur of the breeze; the whole soul, passing into one sense, aggrandizes that sense and starves the rest.

12. The acuteness of the senses in animals may in like manner be accounted for. The scent of the dog resolves

itself into the identification of an exceedingly faint impression. An effluvium on the nostrils of a pointer, revives the former impression of the smell of a hare, while on the human nose the same effluvium is utterly devoid of effect. Here we must attribute the distinction neither to education nor to the force of the association of similarity, but to the acuteness of the smelling organ. Any given smell will produce a far more intense sensation in a dog than in a man. If we take a scent sufficiently strong to be felt by both, as when the hare is brought close enough to be felt as a smell on the human nose, the man is calm in his manifestations, whereas the dog is excited almost to madness. By this we can see, that such is the organization of the smelling organ of the dog, that impressions made on it are transmitted to the brain in a highly magnified state; and further, it may be, that the brain is specially inflammable to a particular class of sensations of smell, an effect to which nothing corresponding is found in the human constitution.

The far-sightedness of birds depends in part on the adaptation of their eyes to distant vision. It corresponds with the far-sightedness of persons habituated to remote objects, or to the change that age makes in the lenses of the human eye. We have had occasion to notice the superior development of the adapting muscles of the eye in birds, whereby the organ can go through a greater range of adjustment than is in the power of other animals.

In the examples, under the present head, we have thus brought into view, as circumstances affecting the recall of past impression by a present, a power operating generally, and three local conditions. Probably in all these instances, the special conditions are of far more importance than the general; but whether the natural or the acquired delicacy of a sense usually tells most, we do not pretend to decide.

SIMILARITY IN DIVERSITY.—SENSATIONS.

13. We now approach the case that contains the greatest amount of interesting applications—the case of similarity

disguised by mixture with foreign elements, the Like in the midst of the Unlike. There is often very great difficulty in recognizing an old familiar object owing to alterations that have been made upon it. Coming back after a lapse of years to a place where we have formerly been, we find houses and streets and fields and persons so altered that we at first fail to identify them; the differences that have overgrown the permanent features are, in many cases, such as to destroy their power of reinstating the ancient impressions. When likeness is thus surrounded with diversity, it is a doubtful point whether the attraction of similars will succeed in reviving the old by means of the new. In these cases of doubtful and difficult reinstatement, there may be observed great differences in the intellectual reach of individuals: of a number of persons placed in a similar predicament, some will be struck with the likeness; the flash of identity will come over them, and the past will stand side by side with its muffled likeness in the present; others again will see no identity, the attraction of the new for the old will, in them, be overborne and quenched by the surrounding diversity.

To trace the workings of the attractive force of similarity in its struggles with the obstruction of unlike accompaniments, I count one of the most interesting problems of mental science; and I trust that, in the course of the illustration that will occupy the remainder of the present chapter, my readers will grow to be of the same opinion. Although any natural defect in this link of reproduction is perhaps less capable of being made up by artificial means than in the case of Contiguity, yet we shall see that here too there are circumstances, under our control, that aid in clearing the way for the reviving stroke of similarity.

14. Before proceeding to the main subject under the present head, namely, the Sensations, I shall advert to the one case of Action, or Movement, that furnishes interesting examples of the working of the present law, I mean articulate action, or Speech. In the numerous and various trains of articulation entering into our education in language, there

are many instances of recurring likeness in the midst of unlikeness, leading to the revival of the past by the present. We are constantly recalling past sayings of our own and of other people, and passages of writings that we have read, by hitting on catch-words or identical phrases when our thoughts are running in some quite different channel. The single word 'phrenzy' uttered with emphasis will recall, in a mind familiar with the passage, 'The poet's eye in a fine phrenzy rolling;' the principal epithet in such a case being enough to reinstate the entire connected train. Through the suggestion of common words, we can thus leap from one passage to another, by the remotest fetches, in an endless succession of recollections. The character of the mind will determine the prevailing character of the revived sayings; in one mind, they will be poetical and ornate; in another, the preference will be for prose melody; in a third, epigram and wit; in a fourth, sententious wisdom and prudential saws. The sayings and passages that have been impressed upon us, in the course of our education, will come up through the medium of common phrases; and the general power of similarity in the mind, modified by the quality of the Articulate sensibility in particular, will determine the abundance of this class of revivals, in other words, the quantity of speech flowing into the utterance of the individual. The force of Contiguity strings together in the mind words that have been uttered together; the force of Similarity brings forward recollections from different times and circumstances and connexions, and makes a new train out of many old ones. I may have learnt, at one time, a passage from Milton, at another, an extract from Pope, on a third occasion, a piece from Campbell; mere contiguity would enable me when reminded of the commencing words of any of these passages to repeat the whole; but the energetic working of similarity causes me to break into any one or all of them, while speaking on some remote subject. I chance to fall upon two or three words resembling an expression in one of the pieces; and, notwithstanding the diversity of the context, the old stream of recollection is re-constituted, and the entire passage brought within my command. The attraction of sameness is here manifested as overcoming the repulsion of diversity. I am uttering a connected series of words, and among these, one, two, or three have by chance the echo of one of the falls of an old utterance; instantly I feel myself plunged in the entire current of the past, and may avail myself of any portion of it to serve my present end in speaking. Neither the unlikeness of the context, nor the totally foreign nature of the subject matter, will stifle the reviving action in a mind very much alive to articulate effects. As Contiguous adhesiveness is measured by the fewness of repetitions necessary to fix a connected speech in the memory, Similarity is measured by the amount of repulsion and disparity that can be overcome, in bringing an old train forward by the force of a new one.

Unlikeness of circumstances and situations is no bar to the revival of past expressions, any more than difference of verbal context and subject matter. A word casually spoken in some present emergency, will often revive a stream of recollections and incidents long past, where that word chanced to figure as an important turning point of the history. It is hardly possible to fall into the phrase 'every man to do his duty,' without being put on the track of our recollection of Nelson's last victory. So the word 'duty' is liable at any time to bring up the Duke of Wellington. These verbal coincidences are one great link of connexion between us and our past experiences; they put us ever and anon upon the track of some bygone incident in our history. And the more alive we are to the influence of words, the larger is the share of reviving efficacy that belongs to them.

The hold that we have of language is not confined to the articulate organs, but extends over the senses of hearing and sight, and is besides influenced by the emotions; and we shall therefore have to recur to the topic on various occasions. The importance of language in the operations of intellect generally, justifies a frequent reference to it.

Besides the general power of Similarity, all the special or local conditions of revival under Feebleness apply to revival under diversity—(1) acuteness of sense, (2) previous familiarity, (3) acquired delicacy or habits of attention; and to these a fourth has now to be added. In the case of a present object bringing up a past, both resembling it, and also differing from it, there is obviously a struggle or contest of attracting similarities. In the example now given—language—a certain passage before the mind may bring up, from the past, another passage resembling in expression, but differing in sense; or a passage resembling in sense, but differing in expression: this shows that both peculiarities have a power of attraction, each for its own kind, although one prevails, and is thereupon called the stronger attraction. ABC is liable to bring up ADE, the likeness being struck on A; or BFG, on the likeness of B; or CHI, on the likeness of C. The attraction of B for some combination where it enters, and of C for a combination where it enters, have to be overcome by A, in order to secure the recovery of ADE. Now, the less active B and C are, the more easily will A predominate and effect the recall; that is, if all the local conditions above specified are of a low order as respects B and C, while the same conditions are well developed in A, the chances in favour of A are proportionally great. Hence, the additional circumstance applicable to Similarity in Diversity is (4) *a low susceptibility, or comparative insensibility, to the points of difference.* A speech will recall by preference other speeches resembling in diction, if the individual is more highly susceptible to language, than to meaning or subject-matter.

15. To pass to the Sensations. In Organic Life, there are many cases of a sensation repeated with new admixtures, serving to disguise its character, and to prevent its recalling the former instances of the same impressions. It often happens that the same organic state is produced by very different causes. A shock of grief, a glut of pleasure, a fit of overworking, an accidental loss of two or three nights'

rest, may all end in the very same kind of headache, stupor, or feeling of discomfort; but the great difference in the antecedents may prevent our identifying the occasions. The derangement caused by grief is more likely to recall a previous occasion of a similar grief, than to suggest a time of overdone enjoyment; the sameness in organic state is, in the case of such a parallel, nullified by the repulsion of opposites in the accompanying circumstances; a state of grief does not permit a time of pleasure to be recalled and dwelt upon; the loss of a parent at home is not compatible with the remembrance of a long night of gaiety abroad. Hence we do not identify the supposed state of organic depression with all the previous recurrences of the same state; unless, indeed, a scientific education has made us aware of the sameness of the physical effects resulting from the most dissimilar causes.

16. Under Taste, we have examples of a like nature. A taste may be so disguised by mixture as to be undiscernible; the presence of the other ingredients operating to resist the reviving power of the one that we desire to identify. In a solution of Epsom salts, we should not be able to discern a small quantity of sugar; the saline bitter of the salts overpowering the sugary taste. Again, when malt liquor becomes sour, we are unable to discriminate any longer the alcoholic taste; the acid taste overcomes every other sensation. If, in such a case, the alcohol is still discernible by any one person, when others fail to perceive it, we should say that such an one's memory had been specially impressed by alcohol.

17. Hitherto I have spoken of sensations identified through actual sameness, the identification being impeded only by others mixed up with them. A case of greater complicacy and more importance is furnished by the existence of sensations really different, but having something in common that cannot be seized by itself. Take as an instance the tastes of the various wines; these are all different, and if similarity acted only in absolute sameness, port would remind us only of port, claret of claret, madeira of madeira, and so on. But we

find that there is so much of a common influence in all wines, that any of them can remind us of a great many others; we, at the same time, noting points of difference, when they are thus brought into comparison. It is this common influence, with its suggesting power, that has led mankind to constitute what is termed a *class*, or a genus, 'wine,' comprehending many widely-scattered individuals. The identification of likeness in the midst of unlikeness, in other words, of a common property, is the essence of this classifying operation. A *class* is distinct from a *catalogue* by virtue of a common resemblance, in the midst of diversity. Again, the class, 'wines,' identified through their common organic sensation and taste, is merged in a larger class when spirituous liquors come to be known. There is felt to be an identity between the principal effect of these liquors on the system, and the effect of the various members of the vinous group. The class is now extended; yet, because of there being some features common to wines that do not attach to spirits, the wines are still retained in a group apart, subordinate to the larger group, or as a species coming under the other as a genus. The addition of malt liquors to the comparison extends the identity still farther, and enlarges the class of substances that suggest one another through the common quality of causing intoxication. These malt liquors being themselves identical in more points than those common to them with wines and distilled spirits, they also make a small species by themselves, contained in the comprehensive genus of intoxicating drinks.

It was not discovered at first that this influence, common to so many substances derived from such various natural sources (the grape, the sugar-cane, barley, oats, rice, &c.), was owing to one sole ingredient occurring under various combinations. The identification had proceeded solely on their common influence on the human system, and not from a knowledge of the common element, alcohol. Had the grouping proceeded on this perception, the case would have been exactly like those above described, where a taste or smell is identified in its mixtures with other tastes or smells. But the substances were classed together, without men knowing whether it was that many different liquors had the same action on the human body, or that there was one substance pervading many compounds, to which the influence was solely owing. It was a generalization of a common internal feeling or attribute, not of a common external object.

Another example akin to the foregoing is furnished by the Pungent Odours. The influence of the various kinds of snuff upon the nose is so well marked, that we readily identify it notwithstanding differences of aroma or flavour. Upon this similarity, we group all the different varieties together, and make a class of bodies, any one of which may be used for any other when the common effect of pungency is desired. The kinds of snuff would doubtless also be identified on the ground of their common origin, the tobacco plant, like wines by the grape. But looking at the subjective sensation of the snuffs, we find that this assimilates itself to a like sensation produced from other bodies ; thus, the odour of smelling salts may by similarity recall the odour of snuffs, and the two different substances will hence be brought together in the mind. If we have at any time acquired the impression of hartshorn, this impression also might be recalled in virtue of its resemblance to these others ; we should then have three distinct experiences summoned up from different times and circumstances of our past history, these experiences presenting three different substances lying quite remote from one another in nature, but now brought together under the view of the mind, through exerting on it a common influence. If our acquaintance with pungent odours had been still greater, others would be recalled to join the group already formed, and we should have amassed, from far or near, a multitude of recollections strung upon one common thread of resemblance, and these recollections would thenceforth be held together as a group in the mind, forming what we term a class, a genus, or a generalization of agreeing objects.

In this instance, there is no external element common to all the bodies producing the pungent effect; the classification is based purely on the common sensation of smell. The smelling salts and hartshorn are identical, inasmuch as both yield ammonia; but the effluvium of snuff is not ammonia, although found to bear a resemblance to it in chemical constitution.

These various identifications put to the test the force of similarity in different individuals. While seized by some minds, they are wholly missed by others; and the reason for their being missed usually resolves itself into deficiency in one or more of the five conditions already recounted—natural delicacy of the sense itself, previous familiarity, acquired delicacy, low susceptibility to the points of difference, and general power of Similarity. Moreover, there may never have been any motive or desire to strike out identities in the department.

18. The illustration of Similarity in Touch might be very copious.

The intellectual sensations of Touch comprise the feelings of Temperature, of Plurality of points, and of Muscularity in conjunction with touch proper. Everything handled for the purpose of discerning its tactile properties affects all these sensibilities; and there may be the greatest variety in their conjunctions, and a corresponding scope for detecting likeness coupled with unlikeness. We identify the soft, warm contact of wool; the cold, hard smoothness of polished stone; the roughness of a file—in the midst of diversity of shape, size, and weight. We identify degrees of weight without much difficulty, unless distracted by some very acute accompanying sensibility, as cold or heat. We recognize tactile shape in variety of surface, material, weight, and size. Our discrimination of distinct properties becomes knowledge only when supplemented by our sense of agreement; a present high temperature is distinguished from a recent lower, and identified with previous experiences of the same intense degree; by which means our notion of that quality is complete. We are thus in possession of classes of things based upon each recurring attribute that we are able to identify in the midst of diverse accompaniments.

19. To take next the sense of Hearing. The analysis of sounds has shown us the complexity of the characters attaching to any one individual sound, and to what extent identity in some of these may be disguised by differences in others. For example, the *pitch* of a note may be readily identified when sounded on some voice or instrument familiar to us; but, on a strange instrument, we are less able to make out the identity. The change of quality in the note, the greater or less emphasis, the different duration of the sound,—as in comparing a piano note with an organ, all tend to disguise the pitch, and to render a more delicate or a more cultivated ear necessary for its discernment. If the same note be played feebly on the violin and thundered on the organ, the great disparity of emphasis will confound the obtuse ear, and stifle the feeling of identity.

The illustration takes a wider sweep, when we suppose a continuous flow of a sound, as in a musical performance or a consecutive address. The effects on the ear being more varied, there is greater scope for tracing similarities, and more opportunity for the obstruction arising from diversity. We can commonly identify an air that we have once known, on all varieties of instruments, and with or without harmonies. But it will happen to persons, little accomplished in music, to miss a known air when played on a full band, while they could readily identify it on a single instrument. Musicians can also identify the key of a piece, although this point of identity must be enveloped in the widest differences as regards everything else. We are also accustomed to ascribe a common emotion to many compositions; we classify airs as martial, gay, solemn, sacred, melancholy, &c. In so far as there is any reality in these distinctions, they are made out by the force of similarity, recalling past and scattered examples of an effect felt at the present moment. A more substantial agreement is that commonly found in the compositions of the same master.

The property of *articulateness* of sound is very apt to be disguised, by strange accompaniments, beyond the reach of identity. Our ear for articulation is formed in the first instance on the voices around us; we identify with ease a letter or a word as pronounced by those; in fact, the casual peculiarities of their manner become, as it were, fused with our sense of the articulations themselves. A child born in Yorkshire acquires an ear for the vowels and consonants of the alphabet as sounded in Yorkshire. If we pass into Middlesex, the articulations correspond without being identical; and we may or may not identify the old words under the new utterance. The experiment would show whether the ear is good as respects the essential quality of articulate form, just as the trials above alluded to show the degree of delicacy as regards the pitch of a note. Some ears are but faintly susceptible to the distinctiveness of the articulations, or to the essential difference between one vowel and another, and between one consonant and those closely allied to it. If such ears happen to be acutely sensible to the qualities of different voices, and to differences of emphasis, or stress, they will be more strongly acted on by the disagreements than by the agreements.

Pronunciation, accent or brogue, cadence and elocution generally, form a large part of the collective impression of articulate utterance: to which we must add gesticulation and manner as apparent to the eye. Taking all these sources of diversity in connexion with the one main feature of articulate utterance, we may derive an unlimited fund of examples of re-instatement made difficult by unlike accompaniments. Voice, pronunciation, accent, cadence, and gesticulation, are inseparable from articulation; and we become accustomed to the sound of words as beset with a particular mode of each of these effects. Often indeed we take up a meaning from manner alone. Accordingly, when we come to listen to strangers, to the people of another province, to foreigners, we experience the difficulty of identifying the articulation in the midst of unusual combinations. The goodness of the ear for articulation proper is submitted to a trying ordeal, as the ear for pitch is tested by the sound of a strange instrument. The trial is greatest of all when we are endeavouring to acquire a foreign language. Here the one effect of the articulation of vowels and consonants, needs to make itself felt amid the distraction of a manifold variety of other effects. Nothing proves so decisively the goodness of the articulate sensibility of the ear, as the readiness to follow a foreigner speaking his own language. The power of identifying the essentials of the articulation in the diversity of all else, is in such circumstances conspicuously manifested. It will happen, however, that a person is more than usually sensitive to some of the accompaniments that do not concern the conveyance of the meaning; an ear strongly impressed with the accent and cadence, and permitting itself to be much engrossed with the different turns of the emphasis and modulation, is by that circumstance rendered more obtuse to the articulate character or to the meaning of the words. The thunder of a diverse and unaccustomed cadence drowns the still small voice of expressive utterance. An acute ear for oratory is thus a great obstruction to the acquirement of languages; so is an eye unduly impressed with gesticulate display. In listening to our own language, spoken in the style that we are accustomed to, the sensitiveness to those accompaniments is in our favour, and brings home the meaning all the more powerfully; but when they are totally changed in character, as when we listen to a Frenchman, we are just as much put out, in identifying the articulation, as in the other case we were assisted.

20. The ear, as formerly remarked, is the principal matrix for embodying our recollections of language. A speech heard is, in great part, remembered as a connected series of auditory impressions. Our recollections of this class are liable to be recalled by similarity, under circumstances of diversity. We can scarcely listen to any address, without being reminded of many past addresses, through occurring phrases, tones, and peculiarities that lead us into some formerly experienced

track of impressions on our ear. The greater our susceptibility to the articulate quality that governs distinctness of meaning, the more readily shall we fall upon previous addresses that correspond in phraseology; if we are more alive to tone, accent, and cadence, these qualities will preside over the recall of the former occasions when we were in the position of listeners. In this way, we are led to detect similarities of manner and phrase in different speakers; we hunt out imitation and plagiarism, and institute comparisons among various styles of address. With regard to the diversities tending to obstruct the reviving impetus of likeness, they may lie in the context of the agreeing phrases, or in the other peculiarities not connected with meaning; or else in the subject matter and sentiment of the address. As in former cases, we pronounce the attraction of similarity powerful when it breaks through a great discordance, and the discordance great that arrests the reviving stroke of similarity; in fact, we must measure each force by the opposition that it conquers. If a verbal likeness has the effect of interpolating some old recollection, in a subject most discordant with it, we pronounce the conditions aiding verbal similarity to be highly developed, or the regard to the subject feeble, or both.

21. Among Sensations of Sight, the occasions for identifying sameness in diversity correspond with the wide range of the sense. We can identify *colours* in spite of difference of shade; obtaining classes of blues, of reds, of yellows. The existence of such classes implies both sameness and difference; the class-name being derived from the sameness, or the effect common to all the individuals. When a colour is intermediate between two principal colours, as between yellow and red, we may fail to class it with either, not being struck with any feeling of identity in the case; whereupon we constitute a new colour, as orange. It may also happen that, to one mind, the colour may appear as red, and to another yellow, according to the previous impression that it most readily revives. Next as to the property of *lustre:*

a varnished substance, a glossy fabric, a polished surface in metal or stone, a film of wet, a clear brook, a covering of glass,—all strike the mind with a common effect of brilliancy ; and if the power of similarity is sufficient, each one of these effects may recall the others, so as to muster in the present view a host of things, very different in general appearance, but all agreeing in a particular impression. Looking at a brilliantly polished marble chimney-piece, one man may be reminded only of polished stones of various kinds ; another, breaking through a greater shroud of diversity, compares the effect with metallic polish. Speculating yet farther on the kind of influence exerted on the mind by such effects, a third person brings up a still more remote subject, varnished surfaces ; from these he may proceed to glossy silks and polished leather ; and, by a stretch still more remote, he may include in the comparison the effect of a pebbly bottom through a clear running rivulet. But in order to carry an identity so far as would be implied in this series of objects, it would be necessary that one should have not merely a feeling of the common effect of lustrous brilliancy, but also a notion of its depending on a transparent covering over a mass of colour. Such notion, added to the feeling of effect, might enable one to break through the great difference between a marble chimney-piece and a pool of water.

In the combinations of colour with visible Form and Size —the optical with the muscular impressions of sight—we have an additional scope for tracing likeness amidst diversity. We identify a common colour through all varieties of objects, large, small, round, square, straight, crooked, here and there and everywhere. Thus it is that we have in our mind a class-notion for every colour—a common impression of white, red, or blue, obtained from many diverse objects. According to our susceptibility to colour, is the number, the depth, and the permanence of these common effects ; in other words, the distinct shades of colour stored in our recollection. The work begun by Discrimination is completed by

Agreement; both functions concurring to form abiding impressions of colours. We identify every various shade in the midst of diversities of material, form, size, and surroundings.

The identification and generalization of *forms*, in the midst of every possible difference in colour and dimensions, opens up another vein of illustration. We identify a circular outline in some bodies; the oval shape in others; there is an infinity of classes determined by form, including not merely the regular figures of Geometry, but all the recurring shapes in nature and art—egg-shaped, heart-shaped, pear-shaped, vase-shaped, cup-shaped, lanceolate, &c., &c. These comparisons arise out of identity in the attribute of form, seen through diversity in all other respects. Most of the identifications are sufficiently easy to strike any observer; while instances occasionally arise where only a certain number of minds are struck with the likeness, or experience the revival of the old upon the new. Thus, in the descriptions of botany, the shapes of leaf and flower are often represented by comparisons that are far from apparent to an ordinary observer, demanding the familiarized perception of the botanist. In anatomical descriptions there is not unfrequently an analogous want of obvious resemblance.

The case of mathematical forms and artificial diagrams is both peculiar and interesting; but the important strokes of likeness in diversity that occur in science, are rather more complicated than the examples falling properly under our present head. The generalization of the forms themselves—of triangle, square, parallelogram, ellipse, &c.—through differences of subject, is all that we can quote on the subject of tracing similarity among our sensations of sight. And we may remark here, as on a former occasion, that a strong sensitiveness to the other properties of things, that is, to their colours, dimensions, material, uses, influences on the feelings, &c., is an obstruction to the process of identifying the mathematical form. A burning volcano suggests a comparison, not with the diagrams of the cone in a book of Geometry, but with images of conflagration and explosive energy.

Of forms not mathematical, we have the alphabet and the other artificial signs and symbols, used both in business operations and in science. In deciphering bad hand-writing there is scope for identifying sameness in diversity. This is like the case of obscure articulation discussed under hearing. A strong sense of the points that make the characteristic difference of each letter, and an obtuseness to all the unmeaning flourishes, are the qualities of a good deciphering head. In proportion as a reader is carried away by ornamental shapes, his power of making out the meaning is impaired. This is the exact parallel of what was said above respecting the effects of over-sensibility to oratorical cadence.

The important case of the revival of Language, already brought up, under both articulate action and the sense of hearing, comes in here also, inasmuch as written language appeals to the eye, and is rendered mentally coherent in the shape of impressions of sight. What was said above on the resuscitation of past addresses and sayings, through listening to some one speaking, applies to the reader of books. Forms of language and phrases affecting the eye, recall their similars from the past, and break through a greater or less amount of unlikeness, so as to make present at the same time matters written at different places and occasions. An eye very much arrested and impressed with language is to that degree prone to such revivals; but according as the written symbols are regarded purely as a medium for conveying ideas or information, there is a restraint on the tendency to mere symbolical identification. We have here, as formerly, occasion to note the *verbal* aptitude of the mind, in contrast to the hold taken of the things that are the subject-matter of language, whatever those may happen to be,—whether science, history, poetry, business transactions, or any other. In the verbal mind, as a whole, we can remark the following peculiarities,—1st, The physical power of articulation well developed; this is shown in the easy acquirement of all the positions of the voice and mouth requisite for speech. 2nd, A good articulate ear, as proved by the test of discrimination. 3rd, An eye for arbitrary visible forms, as in alphabetical or written composition. 4th, General Retentiveness, or power of contiguous adhesion on the whole. An acquisition so multitudinous cannot prosper unless the general power is well developed. 5th, A certain enjoyment of the exercises of speaking, hearing, and reading, apart from the further ends served by these ; this circumstance inspires and sustains the exercise of those lingual functions. To these positive peculiarities, may be added a negative aid, namely, comparative indifference or insensibility to subject-matter. This is the only thing wanted to enable the Faculty of Language to run riot, as we occasionally find it in our experience of men and women.

The artistic forms are a class distinct from both the mathematical and the symbolical. In them the identity is partly in the literal outline, as traced upon the eye, and partly in the effect of it on the mind, as an object of beauty or grace. The last requisite, being the essential feature, must rule the mind in summoning resemblances from the past. Thus, in the drapery of a statue, we identify some effect that we have formerly been impressed with, and the stroke of similarity brings up the former objects to the recollection ; on which we find that there is by no means a literal coincidence of lines, and curves, and folds ; but the æsthetic similarity has broken through these and other differences, and has reproduced an instructive array of artistic parallels. A deep feeling of literal or mathematical form would be repugnant to the aims of the artist.

The identification of one Scene of Nature with another may present all degrees of difficulty, according to the predominance of agreement or of difference, and according to the tendency of the mind to be impressed with the one or the other. If the sameness is in form and outline—in the arrangement of mountain, valley, and river—the reviving stroke of similarity turns on the attraction of the mind for unsymmetrical shapes and groupings, one of the features in the catholic susceptibility of the naturalist's mind. If the resemblance to certain other scenes lies in richness, massiveness of colouring, and strength of contrasts, the chord to be struck is of a different kind; and such scenes will be revived in a mind alive to these effects, notwithstanding, perhaps, very great differences in the groupings, or formal arrangements of the component parts.

The same observations are applicable to any other mixed objects of sight or spectacle. When one dress or uniform recalls others; when the *mise en scène* of a dramatic representation suggests parallels from our former experience in those things; when one face recalls another by similarity; or even when a picture revives the original;—in all such cases, the interest, for our present theme, lies in remarking what are the agreeing particulars, and what are the points of discord; whence we can assign the quality of mind that will experience the recall upon any given attribute.

The General power of Similarity would operate alike on all kinds of forms and on all varieties of objects, reviving with equal readiness the similar in colour and in shape. But this general power is modified by the acuteness of the sense, as well as by special education, which deepens the hold that we have of some one class of impressions, and makes us all the more ready to fall into that particular set. Hence it never happens that any individual is equally prone to restore likeness in colour, in geometrical form, in cypher and symbol, and in æsthetic effect.

The last class of objects coming under sensations of Sight are *visible movements*. Among those agreeing in one or more points, classes are made up, and names given indicating the agreement. The flight of projectiles, with considerable disparity, has a common character. In like manner, we have circular movements, elliptic movements, rectilineal movements, uniform movements, accelerated movements, rotation on an axle, pendulums, waves, zig-zag movements, waterfalls, explosions, &c. Under all these, we may have great diversity in the range and the speed, as well as in the thing moved. The movements of animals afford many other varieties ; in quadrupeds, the walk, trot, canter, gallop, shamble ; in birds, numerous characteristic modes of flight ; the darting of the bat, the frog's leap, the serpent's undulation, the crawl of the sluggish snail. By the stroke of Similarity, we bring together in classes a great many instances isolated in their occurrence, and keep hold of them by class-names. We thus generalize the grand varieties of swimming, flying, two-footed locomotion, &c. ; and, within each of these, we have a number of minor classes formed on still closer likenesses. In the flexible and various action of a human being, we have characteristic types of movement and display. The gait in walking, the action in speaking, the mode of performing any work or operation, the movements on the stage,—are so many objects that excite our notice, and sink into our minds as permanent recollections. The collective movements of multitudes, either in orderly array and disciplined precision, or in inorganic tumult and confusion, impress themselves upon the view, and spring up as memories in after times. The moving life, over the face of the globe, and in the habitations of men, is more interesting to us than the still life ; it contains more matter of emotion and excitement, and is consequently more dwelt upon, both in present reality, and in idea.

Here, therefore, the force of similarity has a wide arena to perform in. The recurrence of sameness in the midst of greater or less diversity in all these various movements, leads to identification more or less easy. We identify a style of acting on the stage, a dance, a gait, although the circumstances are very different from the examples lying in the memory. If the agreement is not literal, but in a certain general spirit and effect, a strong sense of the literal will be a bar to the recovery of the resembling cases in the past. If we are very sensitive to the stirring effects of movement in general, we are not so likely to identify the special mode. Movements may be divided in a manner parallel to the three-fold division of forms ; *mathematical* or regular movements, as rectilinear, circular, elliptical, &c., comprising all the continuous movements of machinery, and all movements that can be numerically calculated or geometrically traced; *symbolical* movements, or those used for arbitrary signs, such as the gesticulation accompanying directions, commands, instruction, and the like, telegraphic signals, the alphabet of the deaf and dumb, the characteristic gait and movements whereby we discriminate persons and animals; lastly, *æsthetic* movements, or all those that touch the sense of beauty and the interesting emotions. Different minds are variously susceptible to these three kinds, and identify one sort by preference over the others. The æsthetic sense leads to a revival on that point of resemblance, and obstructs the disposition to classify movements according to their mathematical character, or their arbitrary meaning. The most literal and disinterested susceptibility is that manifested to the symbolical and arbitrary, where neither calculable regularity nor artistic beauty imparts any attractions. The signals of a telegraph, the motions of a fugleman, the signs used in converse with the deaf, may be ranked with cyphers and alphabetic letters: they give scope for pure intellectual identity and discrimination; they require to be closely observed and literally compared with those previously known; the differences are arbitrary, and so are the agreements. Their easy recognition farther depends on a good adhesiveness for visible forms, and on the absence of emotional preferences.

22. There is some interest attaching to the attributes common to Sensations of Different Senses. Impressions, reaching the mind through different avenues of sense, are yet found to have a sameness in the mental feeling or the emotion, this sameness being necessarily accompanied with the difference due to the diverse entries whereby they reach the brain. For example, many tastes and smells have the character that we call sweet; but there are also effects on the ear, and on the eye, with so much of the same character, that we apply to them the same epithet. So, the character of 'pungency' is common to sensations of all the senses; under

taste, we have it in peppered meats; in smell, we have sal volatile; in touch, a scalding warmth; in hearing, drum and fife music; in sight, intense illumination. The amount of sameness in these various sensations is such that one often recalls the others. The identity has long since been struck in such instances; and is clenched and handed down by the use of a common term, as in the above case of 'sweetness.' The opposite quality, 'bitter,' primarily applied to the sense of taste, has been extended to the emotions, as when we speak of the bitterness of disappointment or of remorse. The quality that we call 'delicate' has original reference to Touch, but through similarity, it is looked upon as a mode of sensation in all the other senses. Comparisons are instituted between sights and sounds; and the phraseology of the two arts—music and painting, is made interchangeable. A picture is said to have a certain *tone;* and a piece of music is, by a less common figure, spoken of as richly *coloured.* The feeling of 'warmth' is identified as belonging to effects that have no connexion with heat; we hear of warm colours, and warm affections. Notwithstanding the great disparity there is between an actual sensation of heat, and a colour or a tender affection, there is a degree of sameness sufficient to break through the discordance in other respects, and to cause the stroke of identification. The designation of one class of sensations as pains, and of another as pleasures, is also the identifying of a common character in the midst of great diversity; but these qualities are usually so well marked in the mind, being, in fact, the prime movers of our actions, that no amount of diversity can prevent us from recognizing either the one or the other; indeed, a pain not identified as such, that is, not recalling our former painful experiences, would really be no pain.

These generalizations among the feelings of our different senses teach us the existence of common mental effects arising out of very different outward causes, and are, in fact, so many discoveries regarding our mental nature. They also serve as illustrations, one of another, in our descriptions of feelings, whether in the common conversation of society, in the higher sphere of poetic delineation, or for the purposes of science, as in the delineations of the Senses attempted to be given in this work. If we are endeavouring to convey to others some state of feeling such as they have not experienced, we bring before their view an identical or parallel state that they have experienced; and therefore we require to possess, through the identifying action of similarity, a store of such likenesses. This is a frequently occurring attempt in poetry, one of whose objects it is to produce new emotions in the minds of men. The illustration of the feeling roused in the mind of Antonio by music is effected by a complicated reference to the other senses.

Oh, it came over me
Like the sweet south upon a bank of violets,
Stealing and giving odour.

CONTIGUOUS AGGREGATES.—CONJUNCTIONS.

23. Under Contiguity, we had to notice the aggregation of impressions derived from many different sources, through the circumstance of their proximity, or their striking the mind at the same time. I exemplified the association of Feelings of Movement and Sensations with one another, in the notions that external objects create within us, as in the complex idea of an apple, or a ring. I remarked, further, that in many objects the mental impression overflows the immediate sensible impression, as in the whole class of Tools, with which are associated *uses*, that is, actions and reactions upon other bodies. In the more profound knowledge of natural things furnished by experimental science, there are similar aggregates of associated impressions; as the chemist's idea of sulphur.

Now, wherever there is much variety or complicacy in the impressions of outward things, there is room for the detection of likenesses in the midst of diversity. An object acts upon four different senses; the effect on one sense is identical with an effect formerly felt, but the collateral effects on the three other senses are quite different. I take in my hand a ball of glass ; to the touch, it is the same as a ball of polished stone, and might recall the remembrance of such a ball if I had chanced to have been previously cognizant of one ; but when I look at it, and hear the ring that it makes on being struck, the disparity is notable in both points, and would probably prevent my getting upon the old track of the marble specimen. The most impressive feature of the object being its brilliant effect on the eye, this would have èvery chance to rule the identifying operation, and prevent me from recalling an object entirely destitute of this peculiarity. There might, however, be circumstances to carry my attention off from this effect, in which case the round smooth touch might start forth to the dignity of striking the recall.

In the popular classifications made among familiar objects, the identifying process is seen habitually at work. Looking out on the landscape, we observe an elevation of the ground, or an ascent from the ordinary level to a high point or peak ; we note this appearance repeated under a great variety of shapes, and in different situations ; we are not prevented by the disparity from recognizing the sameness ; and every new individual, by similarity, re-instates the old. We thus bring together in the mind an array of objects widely scattered in nature ; we give them a common name, mountain ; we predicate of each new example the peculiarities that we have found attaching to the previous ; we then know, without a trial, that if we were to ascend any one, we should experience a wide prospect, a diminishing temperature, and an altered vegetation.

In the same way, and with similar consequences, do we classify numerous other groups of natural objects ;—cities, seas, lakes, rivers, forests, cultivated fields, quadrupeds, birds, fishes, &c. Natural History improves upon the popular classifications ; it both searches the globe for materials, and subjects them to careful comparison. The progress of Natural History knowledge has been partly in the number of objects discovered, but partly also in the transition from superficial to *deep* identities. In the time of Aristotle, animals were classified according to the element they inhabited; one class dwelling on the land, another in the sea, a third in the air: this point of identity being so prominent and forcible that it arrested every one's attention. Each of these classes could be subdivided by forming minor groups on still closer resemblances; thus, we should have, on the Earth, bipeds, quadrupeds, reptiles, &c., each of these groups being the assemblage of a number of individuals recalled to the view by special identities. So in the Air, the insect multitude would be readily marked off from the feathered tribes. It was not difficult to form classes such as these. But, more profound enquiry has developed features of identification carrying with them a greater amount of agreement, and on points of more value as knowledge, than in those ancient groupings. Birds are now identified, not by the circumstance of their flying in the air, but on the fact of their bringing forth their young in the egg, by their feathered structure, their warm-blooded circulation, &c. Instead of the old group of quadrupeds or animals walking on all fours, we have the class *mammalia* (which suckle their young), including both man and quadrupeds, and certain animals of the sea and the air.

24. The operation of Similarity in such classifyings and re-classifyings as the above, has a very high interest; it sets forth the workings of genius, and the history of science, and of the human mind. The reader has not as yet been prepared for fully carrying out this explanation. It is necessary first to dwell upon less complicated instances. I might follow the order adopted in developing the Law of Contiguity, and specify instances of the aggregation of impressions of the various senses—the Organic sensibility with Taste, Smell, Touch, Hearing, or Sight; and it would be easy to lay hold of many cases of identity in diversity among such aggregates. Things affecting the palate alike may yet be very different to the touch and the sight, as in the different varieties of the same alimentary substances,—bread, butter, flesh, &c. Objects

that are identical to the eye may yet differ to the taste and the smell, as water, alcohol, and white vinegar. We make a class founded on the common peculiarity, and give a designation implying that, and no more. If, however, the taste or smell is the point we are bent on studying, we do not pass from vinegar to water, but to other sour bodies, as the common acids.

25. Without pursuing farther the instances of aggregate impressions on a plurality of senses, let us next advert to the compounds of Sense and Association. Tools, implements, machinery, and all objects of practical utility, make a class that may stand first in exemplifying this aggregation. A knife, for example, is not simply an object of the senses; it is this and something more. Along with the sensation that it produces on the touch and the sight, there is an associated impression of its use, or of the cutting operation: and we are almost unable to regard it apart from this other circumstance. The appearance of a knife lying on the table is not the whole knife: the appearance of it in the hand while we feel its form and dimensions, coupling sight and touch, is not the whole knife; they are at best but signs or suggestive particulars that revive in the mind, by association, the full notion of the object. Here, therefore, we have a complication of sense and intellect, of impressions made by an actual object, with ideal or associated impressions, arising from previous junctures when we have seen it put to its use. In this association of sensible appearance with use,—the last being only occasionally seen in the reality, and therefore for the most part an idea, or a potentiality,—we have abundant room for the exercise of tracing likeness yoked with unlikeness. We may have similarity in form with diversity of use, and similarity of use with diversity of form. A rope suggests other ropes and cords, if we look to the appearance; but looking to the *use*, it may suggest an iron cable, a wooden prop, an iron girding, a leather band, or bevelled gear. In spite of diversity of appearance, the suggestion turns on what answers a common end. If we are

very much attracted by sensible appearances, there will be the more difficulty in recalling things that agree only in the use; if, on the other hand, we are profoundly sensitive to the one point of practical efficiency as a tool, the peculiarities not essential to this will be little noticed, and we shall be ever ready to revive past objects corresponding in use to some one present, although diverse in all other circumstances. We become oblivious to the difference between a horse, a steam-engine, and a waterfall, when our minds are engrossed with the one circumstance of moving power. The diversity in these had no doubt for a long time the effect of keeping back their first identification; and to obtuse intellects, this identification might have been for ever impossible. A strong concentration of mind upon the single peculiarity of mechanical force, and a degree of indifference to the general aspect of the things themselves, must conspire with the intellectual energy of resuscitation by similars, in order to summon together in the view three structures so different. We can see, by an instance like this, how new adaptations of existing machinery might arise in the mind of a mechanical inventor. When it first occurred to a reflecting mind that moving water had a property identical with human or brute force, namely, the property of setting other masses in motion, overcoming inertia and resistance,—when the sight of the stream suggested through this point of likeness the power of the animal,—a new addition was made to the class of prime movers, and when circumstances permitted, this power could become a substitute for the others. It may seem to the modern understanding, familiar with water wheels and drifting rafts, that the similarity here was an extremely obvious one. But if we put ourselves back into an early state of mind, when running water affected the mind by its brilliancy, its roar, and irregular devastation, we may easily suppose that to identify this with animal muscular energy was by no means an obvious effect. Doubtless when a mind arose, insensible by natural constitution to the superficial aspects of things, and having withal a great stretch of identifying intellect, such a comparison would then be possible. We may pursue the same example one stage further, and come to the discovery of steam power, or the identification of expanding vapour with the previously known sources of mechanical force. To the common eye, for ages, vapour presented itself as clouds in the sky; or as a hissing noise at the spout of a kettle, with the formation of a foggy curling cloud at a few inches' distance. The forcing up of the lid of a kettle may also have been occasionally observed. But how long was it, ere any one was struck with the parallelism of this appearance with a blast of wind, a rush of water, or an exertion of animal muscle? The discordance was too great to be broken through by such a faint and limited amount of likeness. In one mind, however, the identification did take place, and was followed out into its consequences. The likeness had occurred to other minds previously, but not with the same results. Such minds must have been in some way or other distinguished above the millions of mankind; and we are now endeavouring to give the explanation of their superiority. The intellectual character of Watt contained all the elements preparatory to a great stroke of similarity in such a case;—a high susceptibility, both by nature and by education, to the mechanical properties of bodies; ample previous knowledge or familiarity; and indifference to the superficial and sensational effects of things. It is not only possible, however, but exceedingly probable, that many men possessed all these accomplishments; they are of a kind not transcending common abilities. They would in some degree attach to a mechanical education almost as a matter of course. That the discovery was not sooner made, supposes that something farther, and not of common occurrence, was necessary; and this additional endowment appears to be the identifying power of Similarity in general; the tendency to detect likeness in the midst of disparity and disguise. This supposition accounts for the fact; and is consistent with the known intellectual character of the inventor of the steam-engine.

26. Let us next consider Natural Objects, as seen by the eye of the naturalist, with a view to catalogue and exhaust all their properties and relations. The Mineral, Vegetable, and Animal Kingdoms, as objects of intellectual curiosity and rational explanation, present, in each of their individual specimens, that mixture of the sensible present with the associated absent, above exemplified in the class of tools or machinery. Each mineral, plant, or animal, is a bundle of impressions, of which the whole cannot be made present to the sense at one time; there being a series of actions upon other individuals to be included in the conception, and these usually held together with the assistance of language. The complication thus presented is a degree beyond the preceding group. In Mineral bodies, we have the concurrence of many attributes in each individual, some sensible, others experimental; and it is under the estranging influence of much diversity that all the classes have been formed. Thus, to take the Metals. Some of these have a very large extent of sameness, as tin, zinc, silver, and lead; so, there is a close resemblance between gold and copper, between iron and manganese. But when we come to mercury, a striking point of diversity starts forth; namely, the liquid form. The influence of this diversity, leading the mind away to water and liquids of every kind, would prevent the rise of metals to the view, but for the strong effect of the two qualities—lustre and weight or specific gravity, which, acting by themselves, could suggest by similarity only such substances as silver, lead, tin, &c. This concurrence of two striking points of sameness, overpowers the diverting influence of the liquid state, and brings mercury to the mind's eye side by side with the metals. But these bodies have been identified with others in the midst of still greater discordance. When Sir Humphrey Davy suggested that metallic substances are locked up in soda, potash, and lime, the identification in his mind proceeded upon resemblances purely intellectual; that is to say, making no appeal to the senses, but arrived at through indirect signs, and represented to the mind by tech-

nical symbols. He found a class of bodies that had a close agreement with one another, and were termed salts; he saw that some of these consisted of an acid and the oxide of a metal,—as sulphate of iron, nitrate of silver; others consisted of an acid and a substance called an alkali,—as sulphate of soda, nitrate of potash. Here there were a number of bodies brought together in the mind by general agreement; an oxide of a metal in these bodies suggested by similarity of *function* an alkaline substance, both having the property of neutralizing an acid and forming a salt; it was impossible, therefore, not to class together in one group all substances having this property, which was done before the time of Davy, under the name *bases*. He, then, by a bold venture, asserted that this common property of neutralizing acids, and making salts, grows out of a still closer identity of character, namely, a common composition; in other words, that the *alkalies are oxides of metals* too, and that therefore all the bases contain a metal and oxygen. On putting the suggestion to the proof, it was found to hold good; lustrous metallic substances were actually separated from soda, potash, &c.; and the identity made good to the sense as well as to the reason. But to trace identities of this nature, a highly intellectual conception is required to intervene; salts had to be considered, not as appealing to the touch, the taste, and the sight, but as compounded of ingredients represented to the mind by names, figures, and symbols. Had copperas been known only as it appears in a drysalter's store, no such identifications could have grown out of its comparison with other salts. It behoved to be known as sulphuric acid combined with oxide of iron, or symbolically as $S\,O^3 + Fe\,O$, in order to see an analogy between it and Glauber's salts, similarly represented, $S\,O^3 +$ Soda. The scientific identities proceed on scientific *conceptions*, that is to say, on artificial ways of expressing, by names, numbers, and symbols, the facts that experiment brings to light. The same research led to a stroke of identification that would have been utterly impossible to the common eye, namely, of hydrogen gas with the metals,—a gas with a solid,—the lightest substance in nature with the heaviest. Hydrogen occurs *in connexions* that suggest a metal by the force of similarity, as by its combining with oxygen, and entering into still higher compounds exactly as the metals do. The repugnance between the physical or more sensible properties of hydrogen (gaseous form and lightness) and the properties of the metals, kept back for a time, but did not in the end prevent, an identification on the property of combining chemically in the same manner as these. And in the artificial representations of chemical formulæ, the identity is such as to strike the mind very readily ; but this representation was itself consequent on the recognition of similarity of function in the two cases. An acid is now represented chemically in the same form as a salt, hydrogen standing in the acid for the metal in the salt. Sulphuric acid is H O, S O^3, the sulphate of iron Fe O, S O^3.

27. To pass from the mineral world to the Vegetable. Plants may be identified on many different points, and the same plant falls into different groups of associates according to the feature that predominates in the mind, and determines the stroke of recall. What in the end has turned out the most valuable classification, has often repelled at the outset by obtrusive dissimilarities. In the first Classification of plants, the Trees of the forest would be grouped together, owing to easy identification through their prominent and imposing points of likeness. The Shrubs would make another class identified by the same superficial likeness. The apparently insignificant and artificial identifications made by Linnæus would be repellent to a common eye, and could spring only from minute dissection of the structure, bringing out features of identity hidden in the heart of the efflorescence. The Linnæan classification was properly a fetch of identity in the midst of the widest discordance ; and the mental preparation for gaining this triumph of identification, in the midst of difficulties, was a shutting of the eye to the bold features that held all other minds captive, and a devoted study of the minute and concealed structure. Also, the identifying

reach of similarity in such a mind must have been of a high order, to produce so great a change in the mode of looking at the whole vegetable world, to break down all the old classifications, and compel the adoption of others entirely at variance with them.

The vegetable world presents us with another example of pure attraction of Similarity. The analogy of the flower to the whole plant, first struck the mind of the poet Goethe, and was considered by botanists a luminous suggestion. He saw, in the arrangement of the leaves round a stem, the analogue of the circular arrangement of the petals of the flower, notwithstanding very great diversity of general appearance. So, in the leaf, Oken identified the plant. The branchings of the veins of the leaf are, in fact, a miniature of the entire vegetable, with its parent stem, branches, and ramifications. In the first suggestion of these identities, we have notable cases of the stroke of similarity through a dense medium of diversity. Such identifications (when proved to be genuine and not merely apparent or fanciful), cast new lights over a subject; simplifying what is complex, and giving a clue to what seemed a labyrinth.

28. Our next examples are from the Animal Kingdom. In the classification of animals, we find the stroke of identity falling first upon one class of attributes, as in the divisions into quadrupeds, birds, and fishes; a minuter examination paves the way for a deeper resemblance; certain animals inhabiting the sea are excluded from the class of fishes—as the whale, seal, and porpoise; and certain others that fly in the air (the bats for example) are excluded from the class of birds. This new classification, like the reform of Linnæus in the Vegetable world, proceeded on an investigation of structure, and a disregard of the startling differences that arrest the common eye. It was accomplished by the comparative anatomists of the last century, and is now fixed for ever in the minds of men, by the language expressing the divisions and subdivisions of the animal kingdom.

Numerous interesting comparisons have been discovered between the different parts of animals taken individually. These have been termed *homologies*. One of the first suggestions is attributed to the fertile analogical brain of Oken. Walking one day in a forest, he came upon the bleached skull of a deer. He took it up, and was examining its Anatomical arrangement, when there flashed upon his mind an original identity. The skull, he said, was four vertebræ; in fact, the head was merely a continuation of the back bone, but so expanded and distorted as to throw a deep disguise over the fundamental sameness of structure. That disguise was now shot through, by a powerful fetch of similarity, in a mind prepared by previous knowledge for discovering such likenesses. Oken was evidently a man that sat loose to the existing identifications of things. He had, moreover, a large endowment of general Similarity. It appears further that he had a strong belief in the simplicity of nature, that is to say, in the recurrence, or repetition, of the same structure and the same plan of working, in many various forms and in the most widely separated regions. His convictions on this point went far beyond the reality, as we may see from his writings; for of the many hundreds of analogies that he sets forth in his one work 'Physiophilosophy,' there are probably not twenty that are sound. The intellectual force of similarity in him was under no check or control. He never took any steps to prove the reality of a supposed identification. The identifying stroke of similarity, bringing together, for the first time, things that had previously been looked at in totally different connexions, is the first step in a discovery, but only the first step. It has to be followed up by the labour of comparing minutely all the different things whose resemblance is implied in the identification, and only after this examination is complete, and the result satisfactory, is the discovery realized. Hence the remark, 'he discovers that proves.' Honour belongs to the first suggestion of a discovery, if that suggestion was the means of setting some one to work to verify it, but the world must ever look upon this last operation as the crowning exploit.

The homologies of the skeleton imply a wide range of similarities, sought out through the thickest concealment of diversity. The identity of structure of all animals of the vertebrate class,—mammalia, birds, reptiles, and fishes; the correspondence of the upper arm of the man, the fore leg of the quadruped, the wing of the bird, and the anterior fin of the fish,—implies a very great insight into structure, and a power of setting aside first appearances. The resemblance of the segments of the same skeleton, from the crown of the head to the tip of the tail, constitutes the serial homology, which is the working out of Oken's fetch on the skull of the deer. The discovery of these homologies represents the struggles of the human intellect with the perplexity of the world. In the explanation of nature, first thoughts are seldom correct. The superficial resemblances bring together things that have no deep community of structure, and hence no knowledge is transferred from one to another. The comparison of a salmon with a seal can only mislead; the comparison of a seal with a whale may improve our knowledge of both. When a superficial likeness in two objects,—a sameness in some one prominent feature—is the sign of a deep likeness, or a sameness in many other features, all of great importance, we can apply to the second the whole of the knowledge we have obtained of the first; that is, by studying one we are master of the two, and thus economize our labour. If I find out that a bat is not a bird, but one of the mammalia, I instantly transfer to it all that I know of the common characters of the mammalia: but if I identify a bat with an owl I gain nothing, for the likeness between the two (their nocturnal habits) is superficial or isolated, it does not imply a number of other likenesses, and the comparison is therefore unprofitable. The progress of real discovery consists in seizing these pervading resemblances, and in passing by the others. Often where there is the greatest amount of real sameness, there is the least apparent sameness; which only shows that the vulgar eye is satisfied with a very superficial glance at things.

PHENOMENA OF SUCCESSION.

29. Under Contiguity, we have classified and illustrated the different kinds of succession prevailing around us. Some are Cyclic or periodic, as day and night, the seasons, the heavenly appearances generally; the tides, the winds, the revolution of machinery, the routine of life. Others are successions of Evolution, as in the growth of living beings, and the constructions of human industry. Many are characterized by Effect, or the production of some telling sensation, or sudden change, as a blow, an explosion, a burst of music, a dramatic scene. Apart from these salient manifestations, we have the more comprehensive successions in scientific cause and effect. Lastly, History at large is a grand *ensemble* of succession, whose aspects are innumerable.

The identifications traced among these varieties of sequence, and held together by the use of language, as the common estate of civilized men, have vastly enlarged the sum of human knowledge and the compass of human power, besides yielding much refined gratification. They fall under two great divisions, the Real and the Illustrative; the one implying an identity in the actual subject or intrinsic quality of the sequence, the other implying a sameness in some mode or *aspect* of it. Of the first class are the scientific and practical identities; the second are those that serve as a medium either of intellectual comprehension, or of artistic adornment. When we term certain atmospheric movements aerial tides, thereby identifying them with the tides of the ocean, the comparison is strict and scientific, for both phenomena are caused by one and the same natural power, namely, gravitation; but when we speak of 'a tide in the affairs of men,' the identity is not real, but merely illustrative, through a certain similarity of phase or aspect; the ebb and flow of human prosperity has no dependence upon gravitation, it grows out of quite another class of natural impulses.

30. The illustrative comparisons, however, are not confined to phenomena of succession; they occur equally among

the objects brought in under the previous head, namely, aggregates, conjunctions, or appearances of still life. On this account I prefer to treat Illustration as a separate subject, and under the present head, Successions, I shall merely cite a few examples of the identification of likenesses considered as real, or believed to be real. And to commence with sequences that are periodic or Cyclic :—the revolutions of the year are too much alike to present a case of difficult identification, on which alone any interest hinges. In the rising and setting of the stars, there is one point of similarity that might for a long time escape observation, in consequence of accompanying dissimilarities, namely, that in the same place the stars all rise constantly at the same angle, the angle being the co-latitude of the place; at latitude 60° the angle is 30°, at latitude 50° it is 40°. Now, there are two disguising differences in the rising and setting of the various stars; one relating to the height they reach when at their highest, and the other relating to the time of rising, which last element differs for the same star throughout the year. It takes a steady glance, a ready appreciation of mathematical elements (such as this of the angle of rising), and a considerable reach of the identifying faculty, to seize a community of this kind, in the midst of a dazzling and variegated scene. An absence of poetic feeling would be an indispensable requisite.

In the Vegetable Kingdom, as seen in temperate and cold countries, men soon attain to the generalization of alternating life and death, in the cycle of the year. Notwithstanding the boundless variety and diversity of vegetable nature, this fact, of summer growth and autumnal fading, is too prominent to be disguised by the distinctions between a garden flower and a forest oak. It would consequently be one of the earliest generalizations of the human race living out of the tropics. The same remark would apply to the alternation of waking and sleeping, as a fact of animal life in general. The identification of the daily repose of men and animals generally with the hybernation of some species, would be less obvious, but by no means difficult to observant men; unless, indeed, an artificial obstruction were created by the comparison with death, or with the winter of vegetation, having already got possession of men's minds.

The generalization of the planets, or the tracing of a common character, in spite of accompanying dissimilarity, among these wandering bodies, would be interesting to follow, if we could now recover the history of the process. The discovery of the common fact of their circling round the entire heavens, was by no means easy in the case of the inferior planets, Mercury and Venus; men's minds would in their case be carried away with the more limited circumstances of their attending on the sun, and their appearing as morning and as evening stars.

The successions of Evolution are exemplified chiefly in the growth of living beings. Each plant and animal, in the course of its existence, presents to our observation a number of successive phases. The great salient facts of birth and death are an easy conquest to the identifying faculty. Special modes of growth can be traced among limited groups, which are thereupon formed into classes; as in animals, the Oviparous and the Viviparous. The successions of insect life are more complicated. Close observation of individuals is necessary to strike out these identities; so is the absence of vulgar wonderment, poetic illusion, and strong prepossessions. The physiological department called Embryology, includes the knowledge of the earliest evolutions of animals, and is very much dependent upon identifying the modes of growth of creatures considerably different from one another, as the chicken and the infant. The difficulty in such a case is to prove that an apparent identity is real; so that what is known of the one member of the comparison may, with absolute certainty, be believed of the other. Whereas in other instances the discovery is difficult, but the proof easy; in this the discovery is easy, and the proof difficult. As to the means employed in ascertaining the genuineness of an identity seen by the intellectual glance of similarity, or the *logic* of the case, we are not at present concerning ourselves.

31. The Successions making up Human History offer abundant instances of Similarity. Nowhere are comparisons, good and bad, more abundantly struck. Plutarch is not the only writer that has set to work expressly to construct historical parallels.* In the situations arising in public affairs, in the problems that have to be solved, in the issues of critical periods, and in the catastrophes that have overwhelmed empires, the intellect of enquiring and observing men finds numerous identities. Sometimes we compare the past with the present, sometimes one past epoch with another. And such comparisons are seldom barren efforts of the identifying faculty; they are usually employed for some end of mutual illustration, or in order to infer in the one all the good or bad features belonging to the other. The rise of the British empire is compared, by one class of minds, to the history of the great empires of antiquity; the object of the comparison being to carry out the analogy to the full length of anticipating for Britain a similar course of decay. The parallelisms that set forth popular government, as conducting to anarchy and ending in military despotism, have been repeated *ad nauseam*. But such are not the comparisons that illustrate happily the operation of the principle now under discussion, or that show the results of identification in enlarging the grasp of the human intellect. For these ends, I should choose rather to point to comparisons made in more limited chains of historic succession. The narrower the field of view contemplated, the more likelihood there is of hitting upon a real and instructive comparison. Take the following from GROTE'S *History of Greece*. In discussing the changes made in Sparta by the institutions of Lycurgus, the historian calls in question the alleged re-partition of the lands of the state among the citizens. He shows that this is not stated by the earliest authorities, and that it appears to have gained credence only after the revolutionary proceedings of Agis and Kleomenês in the third century, B.C.; at which time he

* See the interesting volumes under this title, published by Charles Knight.

thinks the idea grew up in consequence of its being strongly suggested by the then present desire for a similar re-division. 'It was under the state of public feeling which gave birth to these projects of Agis and Kleomenês at Sparta, that the historic fancy, unknown to Aristotle and his predecessors, first gained ground, of the absolute equality of property as a primitive institution of Lycurgus. How much such a belief would favour the schemes of innovation is too obvious to require notice; and, without supposing any deliberate imposture, we cannot be astonished, that the predispositions of enthusiastic patriots interpreted according to their own partialities an old unrecorded legislation, from which they were separated by more than five centuries. The Lycurgean discipline tended forcibly to suggest to men's minds the *idea* of equality among the citizens—that is, the negation of all inequality not founded on some personal attribute—inasmuch as it assimilated the habits, enjoyments, and capacities of the rich to those of the poor; and the equality thus existing in idea and tendency, which seemed to proclaim the wish of the founder, was strained by the later reformers into a positive institution which he had at first realized, but from which his degenerate followers had receded. It was thus that the fancies, longings, and indirect suggestions of the present assumed the character of recollections out of the early, obscure, and extinct historical past. Perhaps the philosopher Sphœrus of Borysthenês (friend and companion of Kleomenês, disciple of Zeno the Stoic, and author of works now lost, both on Lycurgus and Socrates, and on the constitution of Sparta) may have been one of those who gave currency to such an hypothesis. And we shall readily believe that, if advanced, it would find easy and sincere credence, when we recollect how many *similar delusions* have obtained vogue *in modern times* far more favourable to historical accuracy—how much false colouring has been attached by the political feeling of recent days to matters of ancient history, such as the Saxon Witenagemote, the Great Charter, the rise and growth of the English House of Commons, or even the Poor Law of Elizabeth.'* The comparisons contained in this last sentence, both suggest the explanation above given of the rise of the belief in question, and impart probability to it when suggested. The same historian has effectively illustrated the general body of Grecian legends, by a comparison with the middle age legends of the Roman Catholic Church. The range of knowledge possessed by an historical enquirer on the one hand, and the force of his identifying intellect on the other, are the sources of his fertility in those comparisons that illuminate the darker specks of the ill-recorded past. Whether those comparisons are strictly applicable and good, depends on a quite different mental aptitude, the accurate judgment, or the logical faculty. We find among historians, no less than among Zoological enquirers, the characteristics of the *Oken* mind; a fulness of analogical suggestion with an absence of the tests of truth.

32. It is not stepping far out of the class of instances typified in the foregoing paragraph, to advert to Institutional comparisons, whether of different ages or of the same age. The social and political institutions of nations and races have often points of agreement in the midst of great diversity; and a penetrating mind—in other words, a strong identifying faculty—can bring together the like, out of the enveloping clouds of unlikeness. It is easy, for example, to identify the fact of government as belonging to every tribe of men that act together; so, it is not difficult for one absolutism to bring to view all the other instances of absolutism that have at different times been impressed on one's mind; and the same with free or responsible governments. By this operation, we gather up various classifications of agreeing institutions, the one throwing light upon the other, and the whole concurring to make one broad luminous effect, which we call the general notion of government; of absolutism, of constitutionalism, &c. The vast complexity and the seemingly endless variety of human institutions are thus simplified; out of chaos order

* Vol. ii., pp. 538-40.

arises, as soon as similarity begins to draw together the agreeing elements of the discordant heap. Our great writers on Society,—Aristotle, Vico, Montesquieu, Condorcet, Hume, Millar, James Mill, De Tocqueville,—have shown admirable tact in this kind of Comparative History, with all the effects of intellectual illumination and expansion that flow from the bringing together of remote sameness. What the historian does incidentally, the writer on Society does upon system; he searches the whole world for analogies, and finds, if possible, a class for every variety that presents itself. Forms of Government, of Legislation and Justice, Modes of Industry, Distribution of Wealth and Arrangement of Ranks, Domestic Institutions, Religion, Recreative Amusements, &c., are identified and classified so far as they agree, with notification of difference; and out of the *particulars* drawn together in a powerful identifying mind, there crystallize, one after another, the corresponding *generals*, and the human reason advances in its endeavours to comprehend this wide subject.*

33. To return to Successions. There remains the comprehensive department of scientific Cause and Effect (in which many of the foregoing instances are included), or those successions where the consequent depends on its antecedent, and is always produced by it. Here we remark, that the same link of causation is often repeated in circumstances so widely apart, that the sameness is veiled from the perception of the general mass of minds; indeed it not seldom happens, that until some preparatory operation has drawn aside the veil, the identity does not disclose itself to the most piercing intellect. Thus, to take the two phenomena—combustion and the rusting of iron—it was not possible for any mind to see a common feature in these two effects as they appear to the common eye. It was necessary to go through a long series of investigations to ascertain the precise import of the two actions apart. Other phenomena had to be interposed having relations to both, in order that effects so unlike

* MILLAR *on Ranks*, and the examination of the Hindu Institutions in MILL'S *History of British India* furnish striking examples.

should be seen as like. The experiments of Priestley upon the red oxide of mercury were the turning point in the *rapprochement.* These experiments showed that when mercury is burned it becomes heavier, by taking in some substance from the air; which substance could again be driven off, and the metallic mercury reproduced. The act of combustion of the mercury was to all appearance identical with the burning of coal in a fire, while the resulting change on the substance—the conversion of the metal into a red powder, might suggest the process of the rusting of iron; the chief point of diversity being the time occupied in the two different operations. Through an intermediate phenomenon like this, the flash of identity might pass between the two extremes. It is now known that these are instances of the same natural action, namely, the combination of the solid material with the gaseous oxygen of the atmosphere.

In the great problem of Inductive Science, namely—to discover the effects of all causes, and the causes of all effects—there is a variety of intellectual operations gone through; the problem puts on many different aspects. But there is constantly manifested the importance of a powerful reach of the identifying intellect. Some discoveries turn upon this exclusively; and no extensive series of discoveries can proceed without it. In truth, the very essence of *generalization* being the bringing together of remote things through the attraction of sameness, this attractive energy is the right hand of a scientific inquirer. To cite the greatest example that the history of science contains—the discovery of universal gravitation, or the identifying the fall of heavy bodies on the earth with the attraction between the sun and the planets;—this was a pure stroke of similarity, prepared by previous contemplation of the two facts apart. Newton had for years been studying the celestial motions: by the application of the doctrines of the composition and resolution of forces to the planetary movements, he had found that there were two influences at work in the case of each planet; that one of these is in the direction of the sun, and the other in the direction of the planet's movement at each instant; that the effect of the first, acting alone, would be to draw the body to the sun; and the effect of the second, acting alone, would be to make it fly off at a tangent, or in a straight line through space. By this process of analysis he had reduced the question to a much simpler state; he had in fact prepared the phenomenon of planetary motion for comparison with other movements already understood. The analysis was itself a remarkable effort of intellect; no other man of that time showed the capability of handling the heavenly motions with such daring familiarity—of intruding into their spheres the calculations of terrestrial mechanics. The perception of identity could not be long delayed after such a clearing of the way. Newton had familiarized himself, as the result of this mechanical resolution of the forces at work, with the existence of an attractive force in the sun, which acted on all the bodies of the system; and he had discovered, by a further effort of calculation, that this force varies inversely as the square of the distance. As yet the phenomenon of solar attraction stood solitary in his mind, but it stood out as a remarkably clear and definite conception, so definite and clear that if ever he came to encounter any other phenomenon of the same nature, the two would in all probability flash together in his mind. Such was the preparation on the one side, the shaping of one of the two individual phenomena. Then as to the other member. He had been acquainted with the falling of bodies from his infancy, like everybody else; and the impression that it had made, for a length of time, was as superficial as it had been in the minds of his brethren of mankind. It was to him as to them a phenomenon of sensible weight, hurts, breakage; demanding machinery of support and resistance. This was the view naturally impressed upon his mind, and, in this encumbered condition, an identity with the pure and grand approach of the distant planets towards the sun, while held at a vast distance from the great luminary, was not to be looked for, even in the mind of Newton, whose identifying reach was, undoubtedly, of the first order. He had been for a length of time in possession of the prepared idea of solar force, without its ever bringing to his view, for comparison, the familiar fact of a body falling to the earth. It was obviously necessary that some preparatory operation should take place upon this notion likewise; some meditative effort that would partially clear it of the accompaniments of mere smash, breakage, weight, support, &c., and hold it up in its purest form, as a general movement of all free bodies towards the earth's surface, or rather in the direction of the earth's centre. There was needed an analytic or disentangling procedure; an operation very distasteful and repellent to the common mind, and stamping the scientific character upon any intellect that is at home in it. At what moment Newton laid his analytic grasp upon this ancient experience of our race, we may not now be able precisely to determine; the commonly recounted incident of the fall of the apple may have been the culminating point, but the course of his studies of terrestrial mechanics was the essential element. One cannot help supposing, that, when the phenomenon was once taken to task in the way he had already been accustomed to deal with such things, he would very soon eliminate the main fact from all the confusing circumstantials, and see in it an instance of the motion of one body towards another, by virtue of some inherent power in the attracting over the attracted mass. This eliminating generalization would present the case pure and prepared to his mind, as the other had already been by a previous operation; and then came the flash of identification, and with it the sublime discovery that brought heaven down to earth, and made a common force prevail throughout the solar system. Not less to his honour than the discovery itself, was his reserving the announcement, until such time as the proof was rendered complete, by an accurate estimate of the magnitude of the earth, which was a necessary datum in the verifying operation.

This great stretch of identification, perhaps the widest leap that the intellect of man has had the opportunity of achieving, not only illustrates the mental attraction of similarity, but also presents in relief the preparation of the mind for bringing on the flash. We see the necessity there was for a powerful mathematical faculty, to seize the laws of the composition and resolution of forces, and to apply them to the complicated case of elliptic motion ; in this application, Newton already made a step beyond any mathematician of the age. We observe, in the next place, the intense hold that the mathematical aspect of the phenomena took on his mind,—how he could set aside or conquer all the other aspects so much more imposing in the popular eye, and which had led to quite different hypotheses of the cause of the celestial movements. This characteristic shines remarkably throughout the scientific writings of Newton ; however fascinating a phenomenon may be, he has his mind always ready to seize it with the mathematical pincers, to regard it in that view alone. His mode of dealing with the subject of light is an instance no less striking than the one we have been now setting forth. There was in him either an absolute indifference to the popular and poetic aspects of a phenomenon, or a preference for the scientific side, strong enough to set all these aside. The example, thus afforded, of uncompromising adherence to the relations of number and measured force, was probably the most influential result of his genius, at a time when physical science was as yet un-emancipated from the trammels of a half-poetic style of theorizing. The purifying or regenerating of the scientific method was far more owing to the example of Newton than to the rhetorical enforcements of Bacon. The human intellect was braced by dwelling in his atmosphere, and his avatar was the foremost circumstance in impressing a superior stamp upon the thought of the eighteenth century.

Besides these two peculiarities of the Newtonian mind—mathematical power, and exclusive regard to the mathematical and mechanical, in other words, the strictly scientific, aspect of the phenomena to be studied—I have indicated a third, which, although not radically distinct from these, deserves separate notice; I mean analytic force, or the tendency to separate the effects that an object has on the senses or the mind, and to concentrate the regard on one particular at a time. Thus we have seen that a falling body produces a very complex impression—a gross and multifarious effect—and this total mass of sensation and feeling is the popular notion of the phenomenon. No accurate knowledge can grow out of such aggregates; they are the soil of poetry, not of science. I shall illustrate afterwards the nature of this force, or impulse, that resists the totalizing influence of a complex object, and isolates for study and comparison its individual effects; I note it here as the volitional, or what may be loosely styled the moral, element of the scientific intellect; it stood forth in singular grandeur in the mind of Newton.

REASONING AND SCIENCE IN GENERAL.

34. Not to mention the examples that we have just parted from, many of the instances of Similarity already adduced in the course of our exposition are strictly of the nature of science. I think it right, notwithstanding, to devote a separate head to the operation of the law in the various scientific processes, with a view to elucidating farther both it and them. I shall therefore make the illustration fall under the four divisions of Abstraction, Induction, Deduction, and Analogy.

ABSTRACTION, *Classification, Generalization of Notions or Concepts, General Names, Definitions.*—These designations all point substantially to the same operation—the identifying a number of different objects on some one common feature, and the seizing and marking that feature as a distinct subject of thought; the identification being a pure effort of Similarity. Thus we identify the different running streams that have come under our observation, in consequence of the sameness that appears prominent in the midst of much diversity; any new one will recall the previous ones ; and they are assembled together in the mind not as a miscellaneous aggregate, but as a class strung on a common thread. In this connexion, they add to our information of each ; some we know chiefly at the sources, others at the mouth, some in the mountains, others in the plains; accordingly, we supply gaps in our knowledge of any one by means of the rest. We may go the length of deriving out of the fragmentary views an unbroken whole, an ideal river, that shall include all the features of a complete river; or we may simply choose one that we know better than the rest, as our representative instance, and from it supply blanks in our view of such as we have less perfectly examined. This mutual supply of defects in our knowledge of individuals, is one of the advantages of assembling objects in a class; a second advantage is the substitution of one for another in any practical end ; we know, for example, by some single experience, that a river bank is a convenient site for a town or village, and so we can choose any one of all the rivers in our knowledge for the same object. Here, then, we have first a *classification*, assembled by the attraction of similarity ; secondly, a generalization, or general notion, concept, or *abstract idea*, being some typical river that fairly represents the group, and in which we include only what they all have in common ; this typical river may be one of the number, or it may be a composition out of several. Thirdly, we have the application of a *general name* to the class, the name 'river,' which shall express both the whole, and what each has in common with every other. A fourth operation is all that is necessary to complete the work, namely, to furnish a *definition*, or an expression in language, of the agreeing features or common properties* of the class. This exhausts the series of operations connected with the generalization of objects taken as a total or a unity; of these, the first grows out of pure Similarity, the others suppose a somewhat more complicated process, to be afterwards described.

* A river may be defined 'a natural current of water flowing in an open channel towards the sea,' or to that effect.

Take next the genus of Round bodies. As before, these are first mustered by the attraction of sameness; their identification has the effects, already specified, of mutual enlightenment and mutual exchangeability. Following up this operation, we seize upon some one instance as a representative or typical instance, and our idea of this we call the abstract, or general idea. We can here adopt a very refined method; we draw an outline circle, omitting the solid substance, and presenting only naked form to the eye; this is an abstraction of a higher order than we could gain by choosing a specimen circular object, as a wheel, for it leaves out a greater number of the features wherein circular bodies differ. The mathematical Diagram is thus more of an actual abstraction, than the idea of a river or of a mountain derived from a fair average specimen, or than a composite river or mountain. We may advance, however, from the diagram to a Definition by descriptive words, and we may adopt this as our general conception, and use it in all our operations instead of, or along with, the other. (A circle is defined to be a line everywhere at an equal distance from a point which is the centre.) The definition is, in fact, the highest form of the abstract idea, the form that we constantly fall back upon as the test or standard for trying any new claim of admission into the *class,* or for revising the list begun with.

I do not here enter into the great controversy of Nominalism and Realism, having done so in another place (Mental and Moral Science, Appendix A). There is considerable subtlety in stating the precise nature of that mental element called an abstract idea, notion, or concept. The view now prevailing approaches more or less closely to Nominalism; denying alike the separate existence of abstractions (Realism), and the power of mentally conceiving them as such (Conceptualism). An abstract idea, as stated in the text, is one of three things:—(1) the assembled group of concrete instances, which may be momentarily represented by a single individual; (2) a skeleton outline or diagram, which is still a concrete instance; a circle in Euclid has a definite colour and size, and therefore is not any and every circle; (3) a verbal definition. Sometimes we may have all the three.

The foundation of abstract reasoning must always be an adequate host of particulars. To reason about Justice, we must be able to recall a sufficient variety of just actions to bring to view all the characters connoted by justice, and to exclude those that are not connoted. So with regard to Roundness; we must keep in view several circles differing in material, colour, and size, so as to affirm nothing but what belongs to all circles.

The verbal definition provides a mode of seemingly evading this requirement of a *plurality* of concrete instances. It cannot dispense with the concrete altogether; but it may make one instance suffice. To understand the definition of matter—namely, something inert, or resisting—it would be enough to have one example before us, as a cannon ball, provided we understand that all the properties of the ball are to be excluded from our consideration except its inertness. We may, and do in some subjects, contract the habit of looking at an individual concrete in this exclusive way, which is the greatest stretch of abstraction within the competence of the mind. But this is the act of the mature intelligence.

35. INDUCTION, *Inductive Generalization, Conjoined Properties, Affirmations, Propositions, Judgments, Belief, Laws of Nature.*—The contrast between Abstraction and Induction, as here understood, may be expressed thus: in the one a *single* isolated property, or a collection of properties treated as a unity, is identified and generalized; in the other a conjunction, union, or concurrence of *two* distinct properties is identified. We exemplify the first process, when we bring all rivers into one class, and define the property common to all; the second process, Induction, is exemplified when we note the fact that rivers wear away their beds, or the fact that they deposit deltas at their mouths. In this case two *different* things are conjoined; the flow of water over a country to the sea in an open channel, which makes the idea of a river, is associated with the circumstance of depositing or forming land in a particular situation. This conjunction makes an Affirmation, or a Proposition; the idea of a river by itself, or anything expressed by a noun, is not an affirmation. When we affirm the uniform co-existence of two dis-

tinct facts, we have a Law of Nature, an intellectual possession respecting the world, an extension of our knowledge, a shortening of labour. Of the two conjoined things, the presence of one is at any time sufficient to assure us of the presence of the other, without farther examination. As surely as we meet with a river, so surely shall we find the carrying down of mud to be deposited at the mouth, if the two facts be really connected as we suppose. An abstraction or definition gives us a general *idea ;* it assembles a class of things marked by the presence of this common feature,—the class river, the class circle, the class red, the class planet, the class just,—but does not convey a proposition, a law of nature, a *truth.*

In forming these inductive generalizations, we need the identifying impetus very much as in abstractive generalizations. The case is distinguished only by being more complex ; it is properly a stage beyond the other in the order of discovery, although the two are often accomplished by one and the same effort of the sense and the understanding. Still, in order to arrive at the knowledge that rivers form bars and deltas, we require to have observed the peculiarities of rivers, and to have been arrested by their identity on this point ; standing at the mouth of one, and observing the island which parts its stream, we are reminded, by a stroke of reinstating similarity, of the mouth of some other where a similar formation occurs, with perhaps many points of diversity of circumstances. These two coming together will bring up others, until we have assembled in the mind's eye the whole array that our memory contains. Such is the first stage of an inductive discovery ; it is the suggestion of a law of nature, which we are next to verify. The conflux of all the separate examples in one view indicates to the mind the common conjunction, and out of this we make a general *affirmation,* as in the other process we make a general notion or idea. Now, a general affirmation by language makes a *proposition,* not a definition ; it needs a *verb* for its expression, and is a *law* or a truth, something to be believed and acted on.

In like manner, it is by an identification of the separate instances falling under our notice, that we are struck with the conjunction, in an animal, of cloven hoofs with the act of ruminating and with herbaceous food. To take a more abstruse example. We identify the conjunction of transparency in bodies with the bending of the rays of light; these transparent bodies are of very various nature,—air, water, glass, crystalline minerals; but, after a certain length of observation, the identity makes itself felt through them all. By an *abstractive* process, we gain the general idea of transparency; by looking, not simply at the fact of the luminous transmission, but at the *direction* of the light, we generalize an *induction*, a proposition, conjoining two properties instead of isolating one. The operation of induction is thus of the same nature, but more arduous, and implying greater labour, than the operation of abstraction. The same cast of mind favours both; the same obstructions block the way. To make a scientific induction, the mind must have the power of regarding the scientific properties and disregarding the unscientific aspects; in discovering the refraction of light, the attention must fasten on the circumstance of mathematical direction, and must not be carried away with vulgar astonishment at the distorting effect of light upon objects seen through water or glass. To take in the more abstruse and dissimilar instances, as the refractive influence of the air, there is needed a preparation similar to that already exemplified in assimilating rust and combustion.

Sometimes an induction from a few identified particulars can be *fitted in* to a previously established formula or generalization. The above instance of the refraction of light furnishes a case in point; and I quote it as a further example of the identifying operation. The bending of the light on entering or leaving a surface of glass, water, or other transparent material, varies with the inclination of the ray to the surface; at a right angle there is no bending, at all other angles there is bending, and it is greater as the course is farther from the right angle, being greatest of all when the ray lies over so much as almost to run along the surface. Now, an important identification was here discovered by Snell, namely, the identity of the rate of refraction at different angles with the trigonometrical relation of the sines of the angles, expressed thus :—the sines of the angles of incidence and refraction bear a constant proportion within the same medium, or the same kind of material. Here the observed amount of the bending at different angles, was found to accord with a foregone relation of the mathematical lines connected with the circle. This too may be looked upon as a discovery of identification, demanding in the discoverer not only great reach of Similarity, but antecedent acquirements in the geometry of the circle, ready to be started by such a case of parallelism as the above. Inductions falling into numerical and geometrical relations, previously excogitated, occur very frequently in the progress of discovery. All Kepler's laws are identifications of this nature; his third law, which connects the distances of the planets from the sun with their periodic times, is a remarkable instance. He had before him two parallel columns of numbers, six in the column, corresponding to the six known planets; one column contained the distances, another the times of revolution; and he set himself to ascertain whether the relations of these numbers could come under any one rule of known proportions :—they were not in a simple proportion, direct or inverse, and they were not as the squares, nor as the cubes; they turned out at last to be a complication of square and cube. The law of areas is perhaps an equally remarkable example of a series of particulars embraced in an all-comprehending formula, from the existing stores of mathematical knowledge. In all these discoveries of Kepler, we perhaps should admire the aims, the determination and perseverance of his mind, still more than the grasp of his intellect. We have before remarked, that for a man to extricate himself from the prevailing modes of viewing natural appearances, and to become attached to a totally original aspect, is itself a proof of mental superiority, and often the principal turning point of great discoveries. The identifying faculty in Kepler showed itself less prominently in the particular strokes, than in the mode of taking up the entire problem, the detection of a common character in the motions of the planets and the relations of the numbers and curves. To make that a pure mathematical problem, which really is one, but has not hitherto been sufficiently regarded as such, is itself a great example of the scientific intellect; it was the glory alike of Kepler and of Newton. A previously equipped mathematical mind, a wide reach of identifying force, and an indifference or superiority to poetical and fanciful aspects, concur in all the authors of discoveries that bind the conjunctions of nature in mathematical laws. The great revolution in Chemistry made by the introduction of definite combining numbers, has been even more rapidly prolific of great consequences, than the discoveries that gave Mechanics, Astronomy, and Optics the character of mathematical sciences. The introduction of numerical conceptions into the subtle phenomena of Heat, through Black's doctrine of latent heat, exhibits a stroke of high intellect not inferior to any of those now adduced. The difficulty of seizing the phenomena of freezing, melting, boiling, and condensing, in a bald, numerical estimate, is attested by the lateness of the discovery, if not sufficiently apparent to any one that considers how very different from this is the impression that these effects have on the common mind. The engrossing sensations of warmth and cold, the providing of fuel and clothing, the prevention of draughts, or the admission of cool air—are the trains of thought usually suggested by the various facts of congelation, liquefaction, &c.; to enter upon those other trains is a consequence of special training and endowment, the explanation of which, according to general laws of mind, has been one of the aims of our protracted examination of the human intellect.

36. DEDUCTION, *Inference, Ratiocination, Syllogism, Application* or *Extension of Inductions.*—I have repeatedly urged the value of the identifying process in extending our know-

ledge, by transferring all that has been ascertained in some one case to every other case of the same description. This operation is described under the above titles. It is an Inference, a Deduction, a step of Reasoning, the *extension* of an *affirmation* from the known to the unknown. The discovery of a full identity between the new cases and the old, is a justification of this transference of properties. Having observed, in innumerable cases, that human beings go through a course of birth, maturity, decay, and death, we transfer their fate to those now alive, and we declare beforehand that each and all of these will go through the same course ; this is to make an inference, to *reason*, to apply our knowledge to new cases, to know the future from the past, the absent from the present. So, when we land on the banks of a strange river, we instantly act on the assumption that this river has its origin in high lands, its destination in the sea, and, at its mouth, a deposit of mud of larger or smaller dimensions. The little that we see of the river, by walking a few miles along its bank, is enough to identify it with the rivers already known to us, or with our general notion, or abstract idea, or definition of a river, and on this identity we forthwith transfer all our experience connected with rivers in general, and all their conjoined phenomena, to the newly occurring individual case. When our knowledge comes thus to transcend our actual experience, we are properly said to draw an *inference.*

This process of inference, or extension of properties, therefore, evidently comes of the identifying faculty, by which the new cases and the old are brought face to face before us. If the question be :—given a certain number of particulars, where a natural law is exemplified, to discover other particulars whereto we may extend or apply the law, and so reveal new characters in those particulars—these new cases must be summoned to the view by a stroke of similarity. Thus, Newton observed, in various instances, that, when a transparent body is largely made up of combustible matter, as an oil or a resin, it bends light to an unusual degree; in other words, he made an induction of particulars where combustibility of substance and excessive bending of light were conjoined properties. He next bethought himself of any other substances, besides those in his immediate view, that possessed one of these properties, and his recollection of the refracting power of the diamond responded to his call by a stroke of similarity; he thereupon extended to the diamond the other property, namely, combustibility of material; or *inferred*, what no one had ever experienced, that the diamond is a combustible substance, a singular exception to the class of precious stones. This obtrusion of observed coincidences upon all parallel cases, the active search for new particulars to have the observed properties thrust upon them, is one of the ways of extending the domain of knowledge. The inquirer has got in his hand a clue, and makes a business of following it out wherever he can find an opening; he has made his induction, and lies in wait for opportunities of pushing it out into deductions. In this endeavour, he relies on his identifying faculty; which, if powerful, makes him, as it were, keen-scented for everything in the memory of the past that bears a resemblance to his case; the recollections that, in an obtuse mind, would lie unawakened by the magnetism of similarity, in a mind of a different stamp, start out one by one for examination and choice; and in this lies the harvest-home of the man of intellect.

The converse may next be put. Given an obscure phenomenon, to illuminate it by bringing forward parallels or identities among phenomena that are clear and intelligible; it being supposed that such have actually occurred at some time or other, although in connexions altogether remote from the present difficulty, so that only the force of Similarity can bring them up. The position of the inquirer is altered, but the intellectual operation is the same; to summon the clear to illuminate the dark, or to summon the dark to be illuminated by the clear, must alike proceed on a felt identity, which identity is both the mental link of attraction, and the circumstance that justifies the transference of information from the one to the other. We have already had instances in point; but, instead of recurring to these, I will cite the great identity made out by Franklin between the thunder and lightning of the sky, and electricity, as shown on the common electrical machine. Next to the discovery of gravitation, this is perhaps the most remarkable fetch of remote identification in the history of science. The phenomenon of the thundery discharge was an exceedingly obscure and mysterious action; the natural obscurity of the case was farther increased by the emotions habitually inspired in men's minds; for nothing is more difficult, than to identify, on a mere intellectual similarity, what excites deep emotions (especially fear), with what excites no emotion at all. Only a cool intellectual nature, like Franklin's, was a match for such a case. He could face the evolution of a thunder-storm, and watch it with all the calmness that he would have shown in an ordinary philosophical experiment, deliberately bethinking himself the while of any parallel phenomenon wherewith he could identify and illustrate it. Had he lived a hundred years earlier, his attempt would have been in vain; for of all the scientific facts that could have crossed his view in the middle of the seventeenth century, there was no one that bore upon the case in hand, either obvious or remote. In the eighteenth century, his position was different; the electrical machine was a familiar instrument, and an intelligible account of its phenomena had been rendered; and these phenomena had been expressly studied by Franklin, and were vividly impressed on his mind. To his cool eye gazing on the storm, the forked lightning identified itself (in the midst of a diversity that few minds could have broken through) with the spark of an electrical discharge. This was indeed the only feature of resemblance, unless a favourable accident had revealed some other coincidence, such as the existence of an electrical charge in the clouds before a storm; and the identification must be ranked among the grandest fetches of Similarity. The identity once struck was duly verified, and proved to be a real and not a superficial or apparent sameness; being, in fact, the same natural agent showing itself in widely different situations. Then came all the *deductive* applications; the circumstances known to accompany and precede the discharge of a Leyden jar could be transferred to the electrical storm; the charging of the clouds with one electricity and the earth with an opposite, the increase of electrical tension to the pitch that an intervening insulator could no longer restrain, the shock of discharge,—were seen, through the medium of the familiar parallel, to be the routine of the lightning and thunder of the sky. Every new fact, ascertained upon the machine, could thenceforth be extended to the electricity of the atmosphere; what was not discoverable by examining this directly, could be known through the other, as a deductive inference.

The subject of electricity could furnish many other examples of scientific identification on a great scale.

37. Reasoning by *Analogy.* The three foregoing sections include three out of the four leading processes, or cardinal operations of discovery. (The process of Observation, in one sense the foundation of the whole, does not depend directly upon the faculty we are now discussing.) Every great step in science, exclusive of original observations and experiments, is either an Abstraction, an Induction, or a Deduction. But resort is occasionally had to Analogy, instead of Identity, as a basis of deduction or inference; and for our purpose of illustrating similarity, the striking out of analogies is in point. As an example of analogical reasoning or inference, I may take the comparison of human society to a family, with the transfer of the duties and powers of the head of the family to the Sovereign of the state; this transfer is an inference or deduction, and is often tendered as a reason for the tutelary and despotical character of the Sovereign. The two cases are not identical; they possess an analogy, and a good reasoner remarks how far the analogy holds, and confines his inferences within those limits. In like manner,

human society has suggested the analogy of herds and hives, a comparison much insisted on by Aristotle. A mind well stored with numerous conceptions, the fruit of various studies, and having at the same time a good reach of the identifying faculty, can strike out analogies when identities fail; and by their means a certain amount of insight is sometimes obtainable. We have had occasion to advert to one remarkable scientific analogy, namely, that between nerve-force and common electricity; from which we have not hesitated to draw inferences, in order to support a certain view of the manner of working of the nervous system. Sometimes a farther investigation will convert an analogy into an identity, as was the case with gravitation—if it be true that Hooke came so near as to quote terrestrial gravity as an *illustration* of solar attraction; and as may be the case with electricity and nerve-force. But analogies, in another sense of the word, are similarities of relation in diversity of subject, as in the case of society above quoted, where the analogical character is the permanent fact. The circumstance of evolution attaching to the vegetable and animal kingdoms—the successive stages of birth, growth, and decay—is but an analogy as between a plant and an animal; to a still greater degree is this the case, when we are comparing the mental development of a human being with the growth of a tree, not to speak of the much more remote comparison between the growth of humanity, as a whole, and the progress of an individual animal, or plant. This last analogy is, indeed, too faint to be of any value, and is misleading if deductions are made from it. The logical caution that must accompany discoveries of supposed identity, is still more called for in the slippery regions of analogy.

38. The exemplification now given of Similarity operating in Science, is a nearly complete account of the nature of the intellectual faculty called Reasoning. Some philosophers, as Reid and Stewart, have separated the mental processes concerned in Science into two—Abstraction and Reason. The one is the first of the three operations described above;

the other, Reason, would be interpreted as covering Induction and Deduction. Sir W. Hamilton includes the whole under one head, variously named by him, the Elaborative or Discursive Faculty, Comparison, the Faculty of Relations, and also Thought, in a certain narrow sense, as when Logic is defined 'the science of the laws of Thought.' In the detailed exposition, he divides the operations of the Faculty into two parts, corresponding to the division into Abstraction and Reason.—(Lectures on Metaphysics, II., 277.) This seems the best view to take of the scientific faculty. As regards the mental forces concerned—the chief of these being Similarity—there is no essential difference between Abstraction on the one hand, and Induction, or Deduction, on the other; although the subjects and *products* are so far different, that it is convenient to illustrate them separately.

In remarking above that Similarity does not explain the whole of the scientific faculty, I mean that Abstraction, Induction, and Deduction, frequently involve something besides the bringing together of resembling particulars or facts; what that something is, will be seen in the chapter on the Constructive operations of the Intellect.

BUSINESS AND PRACTICE.

39. In Business or Industry, in the power of intelligence applied to the affairs of life, in Practical Genius, we find exemplified the discovery of deep identities amid superficial differences. In the inventions of practical art, no less than in the discoveries of science, the identifying faculty is called into play.

The labours of Watt, in the steam engine, might with great propriety be farther cited, to correspond with the greatest strokes of scientific identification. Perhaps his 'governor balls' is the most illustrative example for our present purpose. Here he had to devise a method of opening and closing a valve, in connexion with the diminution or increase of the speed of a very rapid wheel movement; and no device in the range of existing machinery would answer this object. He had, therefore, to venture out into the region of mechanical possibility, to seek among mechanical laws in general, or among very remote natural phenomena, for a parallel situation; and he found the only case that has yet been hit upon, namely, the action of a centrifugal force, where two revolving bodies part, or come together, according as the rate of revolution is accelerated or retarded. I am not aware of any stroke of remote identification in the history of mechanical invention, surpassing this in intellectual reach; if such a power of bringing together the like out of the unlike were of usual occurrence, the progress of discovery would be incalculably more rapid. Another instance of Watt's power of identifying a practical situation with some other case where the requisite construction is given, was the suggestion of a lobster-jointed pipe, for conveying water across the bottom of the river Clyde. The inventive genius is ever ready with a suggestion derived from some already existing device, disguised from the sight of other men, either in the arrangements of nature or in the constructions of art. Identifying power, although not expressing everything that constitutes an inventor, will be found a prominent feature in the character. As in the other departments, so here also, the identifying faculty must operate in a suitable region of previous acquisitions and experience.

In the able *administration* of private business and public affairs, we shall often be able to detect the same force at work, although not always designated invention or genius. Either in meeting new cases, or in bringing superior methods to bear upon old, there is a march of mind, an advance over routine, which marks the able administrator; and here too the link of power consists in a more than ordinary force of identification. When a present emergency is exactly like a previous one, it recalls that one without difficulty, and is treated as that was treated; when it corresponds exactly to no one before, a subtler mind is wanted; some parallel must be sought for, away from the routine of cases. Into quite remote regions of affairs, the man of penetration is carried, and finds something in point where perhaps no parallel was ever drawn before. The application of the Syllogism to Law pleadings was a great legal improvement, which has persisted while scholastic forms have gone generally into decay. No routine lawyer was capable of such an innovation. If for illustration's sake we suppose it to have been the work of one person, it implies a mind that came to the study of law previously prepared with the scholastic training, and detecting in the pleadings before the courts a real identity in form with the discussions of the schools, although hitherto conducted with no such method or precision. The transference of the syllogism to the legal reasonings would be the consequence of this feeling of identity; and hence would arise that capital requirement of making parties plead separately to the law, and to the facts of the case, instead of huddling up both in one argument as is usually done in the controversies of every-day life.*

It is usual for practical devices to be first employed in obvious cases, and thence transferred to other cases of a like nature, but of more complexity. Thus, in the great institution of the Division of Labour now so widely ramified over all departments of industry, there could be traced a progressive application; we should find it commencing in manual industry, and in the separation of the primitive classes of agriculturist, artisan, trader, soldier, and priest; and thence, in later times especially, extended into the warehouse and the manufactory, into public business, and into scientific research. In every new step, there would arise, in the mind of some one person or other, a feeling of similarity between the exigencies of a work in hand and the cases where the

* The system of separating the law and the facts, in legal pleadings, did not arise as I suppose in the text, and as might have been the origin, from an application of the scholastic logic, but from our Saxon institution of trial by jury, where the facts were decided on by the jurors, and the law declared by the judge. Nevertheless, the illustration answers our purpose, even in its hypothetical character.

method of divided labour was already in operation; and this identification would suggest the further extension of the practice. I do not at present speak of the faculty required for overcoming the difficulties of detail in all new applications of old machinery (although here too it would be found, that a fertile power of recalling identities in diversity would be the principal instrument of success, in so far as the intellect was concerned), but confine myself to the suggestion of a device taken from some parallel case.

In the progress of free governments, there has been gradually diffused, from the lower to the higher and more difficult posts, the principle of responsibility as a check upon the abuse of power. This practice grew up by a process of extension, until, in the constitutional governments of Great Britain and the United States, it came to include every executive officer in all departments of state. The experience of the practice, with the more humble functionaries, suggested its application to the exactly parallel case of superior officers, and after much struggle, not of an intellectual kind, it got to be introduced into modern free communities, as it had been in the constitution of ancient Athens.

The principle of not interfering with individual tastes and sentiments, except in so far as these affect the legitimate happiness of others, is recognized in certain cases, and has had a tendency to expand itself by assimilation into cases encumbered with obstructive circumstances. Hence has sprung up what amount of toleration in belief and in conduct we now possess; although the difficulty in proceeding far with this extension, shows how effectually the love of domination and of uniformity may stifle the assimilating action of the intellect.

In the suggestions of a practical mind, the identification should always turn upon the *relevant* circumstances, and overcome other attractions of sameness on irrelevant points. To attain to this characteristic is the end of a practical education, which makes the person familiar with the aspects that serve the *ends* contemplated. Thus, a lawyer in recovering, from his past experience, the precedents and analogies suitable to a case in hand, is impelled by the force of similarity working in his mind; but, of the many peculiarities of the case, he excludes the assimilating action of all except the one that would govern its decision before a judge. His education must serve him in making this discrimination; and if (as may happen) he is by natural temperament keenly alive to this one feature constituting legal relevancy, and indifferent to all other points of interest in the case, he is a born lawyer, just as Newton, with his natural avidity for mathematical relations and indifference to sensuous and poetic effects, was a born natural philosopher; or Milton, by the opposite character, was a born poet. That nature should chance to turn out a legal mind is not singular or surprising, for it is only a variety of the scientific or logical intellect, using verbal forms as the instrument, and implying an obtuseness to all the more popular and interesting features of human life. To secure a rigorous uniformity in dealing with disputes, scientific definitions must be made, and equally applied to the most diversified cases.

40. The last form of practical ability that I shall here advert to is *persuasion*. This implies that some course of conduct shall be so described, or expressed, as to coincide, or be identified, with the active impulses of the individuals addressed, and thereby command their adoption of it by the force of their own natural dispositions. A leader of banditti has to deal with a class of persons whose ruling impulse is plunder; and it becomes his business to show them that any scheme proposed by him will lead to this end. A people with an intense overpowering patriotism, as the old Romans, can be acted on by proving that the interests of country are at stake. The fertile oratorical mind is one that can identify a case in hand with a great number of the strongest beliefs of an audience; and more especially with those that seem, at first sight, to have no connexion with the point to be carried. The discovery of identity in diversity is never more called for, than in the attempts to move men to adopt some un-

wonted course of proceeding. When a new reform is introduced in the state, it is usually thought necessary (at least in England) to reconcile and identify it in many ways with the ancient venerated constitution, or with prevailing maxims and modes of feeling, with which it would seem at variance. To be a persuasive speaker, it is necessary to have vividly present to the view all the leading impulses and convictions of the persons addressed, and to be ready to catch at every point of identity between these and the propositions or projects suggested for their adoption. The first-named qualification grows out of the experience and study of character; the other is the natural force of Similarity, which has often been exemplified in its highest range in oratorical minds. In the speeches of Burke, we see it working with remarkable vigour. Perhaps the most striking instance of this fertility of identification for persuasive ends is exhibited in Milton's *Defence of Unlicensed Printing*. Of the class of preachers, Barrow is especially copious in his command of topics of persuasion and inducement towards the performance of religious and moral duties; in him, no less than in Milton, we have everywhere the tokens of an identifying mind of the highest order.

ILLUSTRATIVE COMPARISONS AND LITERARY ART.

41. When two remote phenomena are brought into comparison by a flash of similarity, they may turn out to be repetitions of the same natural agent working in different situations, as in the great examples of lightning and the electrical discharge, the fall of a stone and the moon's gravitation to the earth. The comparison in these cases is real or substantial. It is illustrative and instructive in no ordinary degree, but it is more than an illustration, it is a scientific discovery. The two things identified are so thoroughly of a piece, that we can go all lengths in reasoning from the one to the other. But there is also a useful class of comparisons where real identity is wanting; the likeness being yet sufficient to justify us in interpreting the more obscure and

remote by the more intelligible and familiar of the two; as when, in speaking of the action of supply and demand in commerce, we say that these are constantly finding their level. Here the subjects compared are quite different in their nature, the one belonging to the province of mind, and somewhat obscure, while the other is a physical phenomenon of a very palpable and intelligible sort. Illustration after this fashion is one of our devices for representing to the mind what is either naturally obscure, or accidentally concealed from the view. If we can only see enough of the object to suggest an appropriate comparison, we make use of this to supply the rest. The force of similarity has extensive scope in this department of discovery.

Illustration is particularly wanted to convey scientific notions and abstractions. These are often so artificial and abstruse, that an ordinary mind has great difficulty in seizing them. Such abstruse physical phenomena as the molecular constitution of matter, polarity, chemical affinity, the ethereal undulations supposed to constitute light and heat, the growth of cells in living bodies,—demand to be expressed by comparisons drawn from the seen and palpable. Human actions, feelings, and thoughts, are often so concealed in their workings, that they cannot be represented without the assistance of material objects used as comparisons: hence the great abundance of the resemblances struck between matter and mind. We speak of a clear head, a warm heart, a torrent of passion, a poet's fire. The comparisons brought to bear upon the complexities of social life are likewise very numerous; in fact, there are many social phenomena that we never conceive otherwise than in some species of material analogy. If we take, for example, the different ideas connected with social order and disorder, we find the language almost wholly derived from other things; scarcely a phrase is literal, all is metaphorical. 'The vessel of the state weathers the storm, or is in danger of wreck;' anarchy is described as 'chaos,' 'confusion;' the government is said to be 'shaken,' or 'stable,' or 'tottering;' law is 'erected,' 'overthrown.' We speak of the 'life' and 'growth' of society; when we conceive of progress, it is generally in a figure; we call it 'movement,' 'development,' 'enlightenment,' and so forth.

Of all existing compositions, the writings of Lord Bacon are perhaps the richest in illustrative comparisons of the kind now under discussion; not being scientific identities, and yet serving in an eminent degree the purpose of assisting the popular intellect to embrace difficult notions. In virtue of this surprising power, Bacon's doctrines become clothed in 'winged words.' According to him, science is the 'interpretation' of nature; a comparison that transfixes the mind with the idea of observing, recording, and explaining the facts of the world. Final causes, he says, are 'vestal virgins;' they bear no fruit. But for the simile, it is doubtful if this notion would have stuck in men's minds, and been the subject of keen controversy, in the way that we have seen. His classification of 'Instances,' or forms of experiment and proof, is wholly embedded in strong metaphors; the 'experimentum crucis,' the leading post between two ways, has been adopted in every civilized tongue. Fallacies, or modes of mental bias, are with him 'idols' (*eidola,* false appearances) of the 'tribe,' of the 'den,' of the 'market-place,' of the 'theatre.'

A remarkably powerful identifying intellect, embracing the concrete facts of nature and human life, and the history and literature of the past, is implied in this mode of genius, of which Bacon is the highest instance. The susceptibility to certain classes of objects and impressions determines the particular element that the resuscitating faculty must work in; and in some men this susceptibility is to the concrete in general, rather than to the select and narrow class of the artistic or poetic concrete. Thus, although Bacon's imagery sometimes rises to poetry, this is not its usual character; his was not a poetic sense of nature, but a broad general susceptibility, partaking more of the natural historian than of the poet; by which all the objects coming before his view, or presented to his imagination, took a deep hold, and, by the help of his intense attraction of Similarity, were recalled on the slightest resemblance. Many great writers in English literature have had this strong susceptibility to the sensible world at large, without a special poetic sense; while some have had the poetic feeling superadded; these last are our greatest poets, Chaucer, Milton, Shakespeare.

42. This leads me to notice the second class of illustrative comparisons, those serving not for intellectual comprehension, but for ornament, effect, or emotion. I have said that Bacon's comparisons rarely grew out of a poetic choice, though from their reach, their aptness, and their occasional picturesqueness, they might sometimes be quoted as a kind of poetry. His purpose was to enlighten, not to adorn. But similarity is the instrument of adding ornament and force to compositions; when an idea or picture is intended to kindle emotion of any kind, the effect can always be heightened by adducing illustrative comparisons more impressive than the original. When Sir Philip Sidney, to describe the moving effect of the ballad of *Chevy Chase*, says that it stirs the heart 'like the sound of a trumpet,' he enforces a weaker impression by one much stronger as well as more familiar. The following lines of Chaucer contain two exquisite comparisons for enriching the emotional effect of the subject; they are part of his description of the youthful Squire.

> Embroidered was he *as it were a mead,*
> *All full of freshè flourès white and rede;*
> He sang and fluted gayly all the day.
> *He was as fresh as is the month of May.*

To find powerful and touching comparisons in keeping with a subject, is one of the constant endeavours of the poet, and puts his genius to the severest test. The same demand is made upon the orator, who has also to stir up the emotions of his audience, to kindle their likings and dislikings with the view of moving them in some one direction. Hence, in oratory of every kind, we find abundant use of the figures of speech growing out of comparison. In panegyric, elevating similitudes are employed; in denunciation, such as degrade.

Derision and merriment grow out of low, grovelling comparisons applied to things pretending to be dignified and venerable. Burke's *French Revolution* teems with all the varieties of eloquent comparison. His 'trampling law and order under the hoofs of the swinish multitude,' will be ever memorable among the figures of oratory.

While Shakespeare displays Bacon's power of illuminative comparison, especially in moral maxims and commonplaces, he shines chiefly in the other class, those that heighten the emotional effect (while the genius of both the one and the other abounds in such as have no effect whatever but intellectual profusion). With extraordinary susceptibility to the sensible and concrete of the world, to the full face of nature and life, he had (although not in the *highest* measure) the poetic eclecticism, and dwelt by preference upon the objects that inspired such emotions as an artist is wont to kindle up. He had perhaps the greatest intellectual reach of Similarity on the whole that the mind of man ever attained to ; and his power of adducing illustrative similitudes, through chasms of remoteness and the thickest disguises, will be a wonder and an astonishment to the latest posterity.

43. Of the Tropes and Figures described in Rhetoric, the largest half turn upon comparison. The metaphor, the simile, the allegory—are all forms of illustration by similitude, sometimes serving for clearness, or intellectual comprehension, at other times producing animation and effect. Their invention is due to the identifying intellect, which breaks through the partition caused by difference of subject, to bring together what is similar. The literary and poetic genius of ages has accumulated a store of such comparisons ; many of them have passed into common speech to enrich the dialects of everyday life. No man has ever attained rank in literature, without possessing in some degree the power of original illustration ; and the interval of disparity broken through is a fair measure of the intellectual force of the individual mind in one of the leading characteristics of genius. The original fetches of Homer, of Æschylus, of

Milton, and above all of Shakespeare (I do not pretend to exhaust the list even of the first-rate minds), are prodigious. How remote, and yet how grand, the simile describing the descent of Apollo from Olympus: 'he came like night.' The identifying faculty, be it never so strong, would hardly suffice to bring together things so widely different, but for some previous preparation, serving to approximate the nature of the two things in the first instance, as we have already had occasion to remark of some of the scientific discoveries. Night itself had to be first personified to a certain extent, thereby reducing the immense disparity between the closing day and the march of a living personage down the mountain slopes. Apollo was, besides, the god of the sun.

THE FINE ARTS IN GENERAL.

44. The observations now made respecting Poetry apply with some modification to the Fine Arts generally. In the Arts we may trace out a scale or arrangement, beginning at the most intellectual and ending with those that have this quality in the lowest degree. At one end of the scale, we find distinct examples of the purely intellectual law of similarity; at the other end, scarcely a trace of this operation appears in the form that we have been accustomed to. Poetry, Painting, Sculpture, Architecture, Decoration, and Design, are all conversant with some of the higher intellectual elements: Poetry with speech and the pictorial as represented by speech, the others with visual forms and appearances of various kinds. In storing up and on fit occasions reproducing the materials of those arts, the associating forces of Contiguity and Similarity are extensively brought into play. As to Contiguity, this is obvious enough; as regards Similarity, it may be easily shown. A painter in composing a picture must, in the last resort, choose the component parts, according to their artistic keeping with one another: but in recalling from the past a number of objects, in order to try their effect, he will be greatly assisted by a powerful identifying faculty. We may suppose him to have

in his mind some one plan of a background, which background, however, although containing the main features, does not satisfy his artistic sense. By the attraction of likeness, this part, unsuitable in itself, may recall others resembling and yet greatly differing, and in the array brought up by a powerful intellect, working upon a large foregone experience, some one may be presented answering the requirements of the picture. There may be nothing artistic in the suggestion of the different views; nevertheless, it is only an artist that can make the proper choice. As in poetry, so in painting, in sculpture, in architecture, decoration, and design, there may be a rich intellectual storage and reproduction of the material, apart from the æsthetic feeling; although, by this feeling, the artist must be guided in the use that he makes of the suggestions of the intellect. In all the Arts, examples may be found of rich profusion of unselected matter; the artist mistaking a strong recollection and revival of natural scenery and pictorial elements in general for the artistic harmonizing of the material; still in the departments we are now discussing, no one can attain the highest greatness without some intellectual source of suggestions over and above his artistic faculty. The intervention of high intellect in Art seems to have reached a climax in Michael Angelo; and the limits of human nature forbid us to suppose, that he could at the same time exert the power of delicately adjusting the parts of his compositions, so as to yield the graces and charms that constitute the true distinction, the essence, of Art.

45. When we pass to the second class of Arts, we find intellect dying away and giving place to the genuine artistic stimulus in its purity. Music is the most conspicuous member of the group, and might be taken as representing the whole: the others are, spoken music or Eloquence, Dramatic action and Pantomime, the graces of personal Demeanour and display, and the Dance. In these Arts, the suggestions of intellectual similarity can hardly be said to occur. Undoubtedly, we may by similarity, as already said, identify a common

character in different airs and harmonies ; and, through the presence of any one, others may be recalled to the mind of a composer, and may serve him as hints and aids in a new composition. In such circumstances, I can conceive the operation of a vigorous identifying faculty as enlarging a musician's resources, or as making more readily available to him the examples that have previously impressed themselves on his mind. But this process of imitating and compiling does not fairly exemplify the workings of artistic creativeness. The author of a truly original melody relies upon no such intellectual assistance. By the spontaneous gushings of his mind he flows out into song, and by the guidance of a delicate sense he tunes himself to melody. Other men may imitate and combine such primitive originals in a variety of compositions, but the knowing ear can always detect the work of compilation. Intellect may originate Science, but not Art. There is also the case of strictly imitative music, as when Haydn, in the 'Creation,' tries to reproduce all the sounds of nature. But no good judge ever puts music of this kind high.

I may here refer to what is a common subject of remark, that great musicians and actors, not to speak of opera dancers, have often a very low order of intellect, as measured by the ordinary tests. So, in the charms and graces of society, which are a species of fine art, intellect may contribute nothing. On the other hand, in assisting the less gifted temperaments to take on the charm native to the others, it may operate with good effect ; for this is done by acquisition and compilation, where the intellectual forces always work to advantage. Moreover, in Art, effects can often be reduced to rule, and the comprehending and following out of rules is an affair of the intelligence. In musical compositions, there are rules as to harmony, which any one might act upon ; in elocution, much can be done by merely understanding the directions of an instructor ; and, to stupidity, all such directions are nugatory. Thus it is, that in the diffusion and extension of the least intellectual of the fine arts, recourse may be had to an instrumentality that would never suffice for their creation. It is a remarkable fact in history, that the most highly gifted people of antiquity, in all that regarded pure intelligence, had apparently no originality in music, although they could appreciate and borrow the melodies of foreign nations, and employ these to accompany their lyric and dramatic compositions.

SIMILARITY IN ACQUISITION AND MEMORY.

46. It now remains to show how the force of reinstatement by Similarity can operate in carrying forward the work of Acquisition. We have seen that the associating principle of Contiguity must needs be the groundwork of Acquisition in general; but when any new train can bring up, from the past, some nearly similar train, the labour of a separate acquirement is thereby saved; the points of difference between the new and the old, are all that is left for Contiguity to engraft on the mental system. When a workman is to be taught a new operation in his art, there will necessarily be, along with certain matters of novelty, a large amount of identity with his already acquired habits; hence, in order to conquer the operation, he will require to repeat it just as often as will suffice for fixing, by the plastic operation of Contiguity, all those original steps and combinations. A professed dancer learning a new dance, is in a very different predicament from a beginner in the art. A musician learning a new piece, actually finds that nineteen-twentieths of all the sequences to be acquired have been already formed through his previous education. A naturalist reads the description of a newly discovered animal; he possesses already, in his mind, the characters of the known animals most nearly approaching to it; and, if he merely give sufficient time and attention for the coherence of the points that are absolutely new to him, he carries away and retains the whole. The judge, in listening to a law-pleading, hears little that is absolutely new; if he keeps that little in his memory, he

stores up the whole case. When we read a book on a subject already familiar to us, we can reproduce the entire work, at the expense of labour requisite to remember the additions it makes to our previous stock of knowledge. So in Fine Art; an architect, a painter, or a poet, can easily carry away with him the total impression of a building, a picture, or a poem; for, instead of being acquisitions *de novo*, they are merely variations of effects already engrained in the artist's recollection.

To whatever extent one thing is the repetition of another, the cost of contiguous acquisition is saved. But it is necessary that the repetition or identity should be perceived; in other words, the new lesson must reinstate, by the force of Similarity, all the previous trains that in any way correspond with it. An old acquirement containing many steps in common with a lesson in hand, will be of no use unless it is recalled; should the disagreeing points be so marked, as to cloud the resemblance and stifle the identifying action, nothing is gained by the agreement. It consequently happens, that a mind, feeble as regards the restoring force of similarity, misses the help that past acquirements could often bring to bear upon present efforts; whereas a remarkable energy of recall will make everything available that contains the smallest trace of common matter.

47. To take a few examples from Science. The subject-matter of Geometry embodies a few fundamental notions and processes. A definition, an axiom, a postulate, a proposition, whether theorem or problem, a chain of demonstration, are to the beginner things absolutely new. They must be fixed by the plastic power of Contiguity, and time and concentration must be allowed for the purpose. But, in a good head, one or two examples of each, strongly imprinted, will make all the rest easy; the method or *character* of the devices will be seen through and acquired, and, in every new case, the mind will fall back upon the old ones, for the common element, and concentrate attention on the points of difference solely. When, after going over a few definitions, the learner is im-

pressed with the form and peculiarity of a definition, there is little to acquire in the rest; a slight substitution serves to make a new one out of an old; the definition of a square is easily changed to suit a rectangle. So with an axiom: the first is the most laborious to acquire; every subsequent one is easier than the preceding. When we come to the propositions, there is a very great deal of novelty at first; the whole scheme and management of a theorem or problem—the formality in the statement, and in the order of the proof—are things utterly strange to the young beginner; to acquire a simple proposition is a heavy strain upon his adhesiveness for abstract and representative forms. When this last acquisition is made, it can be turned to account in every succeeding proposition, provided the operation of similarity is not obstructed by the differences that encumber the new cases. Indeed, if each step in the machinery of Geometry were, without much waste of time, firmly learned on the first encounter, and if the reviving power of similarity for this class of things were unfailing, one's progress through Euclid would be a race, such as is recorded of Pascal and Newton. But to the generality of minds, identities in geometrical reasoning are hard to perceive; a difference in collaterals utterly extinguishes the feeling of a similarity in substance, and every new proposition is a fresh labour, as if nothing like it had been gone through before.

What is true of Geometry holds in all the sciences. There is, in each, a vast deal of repetition both of the facts, or subject-matter, and of the formal machinery, although with great differences of mode and circumstance. The law of gravitation runs through all Astronomy; and, in the deepest calculations of the celestial movements, the same mathematical devices are constantly reproduced in new complications. A mind that can seize a calculation once for all, and trace it out in the thickest envelope of diversity, will speedily pass through the intricacies of this vast subject, or of any abstract science. With such a reach of similarity as can suffice to trace out identities hitherto passed over by all former minds working in the same sphere, it is to be presumed that the more ordinary resemblances will be easy to strike; hence an original mind in science is also distinguished for the rapidity of its course along the track of the already known. Much of the acquisitions of a strong intellect are in reality the re-discovery of what is already known; such an intellect perceives the identities of abstraction, classification, induction, deductive application, and demonstrative reasoning, even before they are pointed out by the master. He will make but a poor mathematician that needs to refer to his book for the demonstration of every successive theorem. To all branches of Physics, to Chemistry and Physiology, the very same remarks will apply. It is the nature of an advanced science, to contain innumerable identifications summed up in its definitions and general laws; it was by a vigorous similarity that these were first formed; by the same power they are rapidly acquired.

So in the more concrete sciences of the Natural History group. In Zoology, Botany, Mineralogy, Geology, there has been accumulated a fund of identities in the classifications made of the objects of each. To acquire these classifications, the learner must himself feel the similarity among the individuals; and if his mind is of that powerful kind that can trace many of the likenesses by its own unassisted force, he will speedily string together all the groups that have been formed by others. It is of consequence to a botanist, looking at a new plant, that he shall be able to recall at once whatever other plants he has known that in any way resemble it; he will, in this way, both determine its true class, and stamp it with ease upon his memory.

48. In all the acquisitions of Business, Similarity will likewise bear an important part. If an apprentice at the Law has that deep and subtle identifying power that sees, in every new case, whatever similarity there is in it to some previous one, he saves half his labour; his mind breaks in upon the old track, and on that builds up the new recollection to the extent of the likeness. It is possible to lay under

contribution in this way matters far removed from the subject in hand; one may clench the technicalities of the law, by falling back upon one's miscellaneous knowledge; we may recur to recollections out of all sciences and arts, illustrating the subject as it were to one's self. The mind of Lord Bacon could see in anything before him multifarious analogies to things the most remote; these analogies he could produce to his readers to facilitate their conception of his meaning, and, by the same power, he could shorten his own labour and study. When a clever person surprises us, by instantaneously comprehending and firmly retaining some new method of procedure, we may be quite sure that it has taken hold of him, by resuscitating something analogous out of the storehouses of his past experience; whenever this easy comprehension, and this permanent retention, form part of the mental character, and show themselves in a wide range of subjects, there is sure to be at bottom a vigorous identifying faculty.

49. The case of the Artistic mind presents no essential difference. The storing up of impressions of objects of art is easiest when the identifying power is so strong as to bring up, on every occasion, whatever resembles the object before the view. That a likeness should exist between something we are at present looking at, or listening to, and some past impressions on the eye or the ear, and that that likeness should not be felt, is a misfortune, a loss in every way; and for this reason among others, that, to impress the new object on the memory, we need as much repetition and pains, as if nothing of the kind had ever been experienced before. In reading a poem, the memory is assisted to remember it by all the similarities of thought, of imagery, of language, of metre and rhythm, that one is able to evoke from the traces of former readings and recollections. In a mind keenly susceptible on all these poetic elements, and having the power of similarity highly manifested, almost every touch will rouse up something from the past that has a certain degree of resemblance, and that something will be an already formed

recollection, to eke out the retentiveness of the new strain. The more one's acquisitions advance, the greater the scope for this work of fitting old cloth into new garments; but previous acquisition is of avail, only according as the stroke of resuscitation is good, and is able to pierce the disguises of diversity and altered form attaching to past examples.

50. The retentive power of the mind is not thoroughly tested, except by entire and absolute novelty, a thing that is more and more rare as one grows older. In learning languages, for example, we have less to acquire with every new individual language. Latin prepares for French, Italian, Spanish, &c.; German for Dutch; Sanscrit for Hindostanee. The generalizations of philologists in tracing common roots through all the Indo-European tongues, greatly diminish the number of original ties that contiguity has to fix. All discoveries of generalization have this effect; and if an individual learner can see likenesses, in addition to what have been already promulgated, his labour is shortened by strokes of power peculiar to himself.

51. The Historical Memory might furnish good examples of the intervention of Similarity, in making up the coherent tissue of recollected events. In the transactions of the world, great and small, there is so much of repetition, that a new history is in reality a various reading of some old one; not to mention how much each nation repeats itself through its successive epochs. To a dull mind, a large amount of this repetition is lost for all purposes, the aid to memory among the rest; but a keen-sighted attraction for every vestige of recurring likeness enables one to retain large masses of narrative, at a small expense of adhesive acquisition. Campaign suggests campaign, and one battle another; an intrigue, a negotiation, a career of ambition, a conquest, a revolution, are things familiar to the student gone some way in history; only certain minor features, some of the proportions and circumstantials, are special to the case in hand, and require to be fixed in the memory by pure contiguity. No man could recite a narrative of any sort from a single reading or hearing, if it

were all new to him ; to tell a story, an hour after hearing it, would be impossible, but for our already possessing, among our stored recollections, more than nine-tenths of all the adhesions that enter into it.

CHAPTER III.

COMPOUND ASSOCIATION.

1. HITHERTO we have restricted our attention to single threads or indivisible links of association, whether of Contiguity or Similarity. It remains for us to consider the case where several threads, or a Plurality of links or bonds of connexion, unite in reviving some previous thought or mental state. No new principle is introduced here; we have merely to note, what seems an almost unavoidable effect of the combined action, that the re-instatement is thereby made more easy and certain. Associations that are individually too weak, to operate the revival of a past idea, may succeed by acting together; and there is thus opened up to our view a means of aiding our recollection, or invention, when the one thread in hand is too feeble to effect a desired recall. It happens, in fact, that, in a very large number of our mental transitions, there is present a multiple bond of association.

The combinations may be made up of Contiguities alone, of Similarities alone, or of Contiguity and Similarity mixed. Moreover, we shall find that in Emotion and in Volition there are influences either assisting or obstructing the proper intellectual forces. In the reviving of a past image or idea, it is never unimportant, that the revival gratifies a favourite emotion, or is strongly willed in the pursuit of an end. We must endeavour to appreciate, as far as we are able, the influence of these extra-intellectual energies within the sphere of intellect; but, as they would rarely suffice for the reproduction of thought, if acting apart and alone, we are led to look at them chiefly as modifying the effects of the strictly intellectual forces, or as combining elements in the composition of associations.

The general law may be stated as follows :—

> Past actions, sensations, thoughts, or emotions, are recalled more easily, when associated either through contiguity or through similarity, with *more than one* present object or impression.

COMPOSITION OF CONTIGUITIES.

2. We begin with the composition of contiguities. Instances might be cited under all the heads of the first chapter; but a less profuse selection will suffice. There will, however, be a gain in clearness by taking Conjunctions and Successions separately.

Conjunctions.—For a simple example of a compound conjunction, we may suppose a person smelling a liquid and identifying the smell as something felt before, but unable to recall to mind the material causing it. Here the bond between an odour and the odorous substance is too feeble for reproducing the idea or the name of the substance. Suppose farther that the person could taste the liquid without feeling the odour, and that in the taste he could recognize a former taste, but could not remember the thing. If, in these circumstances, the concurrence of the two present sensations of taste and smell brought the substance to the recollection, we should have a true instance of composite association. If one of the two links is fully equal to the restoring effect, there is no case under the present law; in order to constitute a proper example, each should be insufficient when acting singly. Although there can be no doubt as to the fact of such revivals, we might easily suppose it otherwise. Combination is not strength under all circumstances. A gallon of water at 40°, cannot yield a spoonful at 41°. Ten thousand commonplace intellects would not make one genius, under any system of co-operation. The multiplication of unaided eyes could never equal the vision of one person with a telescope, or a microscope.

We have seen that the *complex wholes* around us in the world, are held together in the recollection by the adhesive force of Contiguity; such objects as a tree, a human figure, a scene in nature, cannot continue in the mind, or be revived as ideas, until frequent repetition has made all the parts coherent. After the requisite iteration, a complex object, such as a rural village, may be revived by the presence of a single portion of it, as some street, or building, or marked locality. But, if the village is one not very well known, that is, if the notion of it is not very firmly aggregated in the mind, the traveller just entering may be not ready to identify it by the first thing that strikes him; he may require to go on till several other objects come in view, when probably their joint impression will be able to bring up the whole, in other words, will remind him what village he is now entering.

So in regarding objects as *concretes*, or combinations of many distinct qualities,—an orange, for example, which affects all the senses,—a fixing process makes the different sensations hold together in one complex idea. Here, too, there is room for the joint action of associating links in recalling an image to the mind. I have already imagined a case of this description, where the united action of smell and of taste was supposed to revive the idea of the concrete object causing them, either being of itself insufficient for the purpose.

3. It is, however, when we go beyond the case of isolated objects, to the still greater aggregates made up by the relations of things to one another, that we can reap examples of multiple association in the greatest abundance. In the connexions of objects with places, with persons, with uses, and with properties, we see numberless occasions for the working of the composite link.

When things have a fixed *locality*, they become associated in the mind with that locality, or with a number of companion objects or appearances. This is one of the means of their restoration to the mind in idea. The sight or remembrance of a harbour recalls the shipping; the recollection of a building brings up its known contents. Conversely, an object that has a fixed place recalls the place, as when St. Paul's reminds us of the neighbourhood where it stands. Now, it not seldom happens, that we desire to recall a place or an object by this single link of connexion, but are unable to do so; a concurring bond may then be brought to our aid.

Thus, to take the case of searching for things lost. When we do not know where to find a thing that we ourselves have put in its place or seen there, the adhesion of place is by that circumstance shown to be feeble. We then run over other links of association; the time when we last saw it; the work we were engaged in; or any fact that would have an association with the forgotten place; we may thus, through a multiplicity of feeble connexions, attain a force of recall equal to one strong adhesion.

The connexions with *persons* frequently prove an assisting link in difficult recollection. Objects become associated with their owners, their makers, their inventors, all persons concerned in their use, or frequenting their locality. When we are unable to recover a thing, by the adhesion between it and other inanimate accompaniments, a personal connexion will often make up what is wanting. Thus, in my endeavour to recollect an array of objects in some museum, there are some that have completely escaped me; the association of these with their place in the building, and with the adjoining objects, is not enough; but when I chance to recall the donor, the collector, or maker, along with these other adjuncts, the vanished individuals may be made to re-appear.

It happens likewise that things are recalled by plurality of association with persons, each link being too weak alone, but made powerful by union. I meet some one in the street, and make an ineffectual attempt to remember where I last saw the same person: by-and-by some one else occurs to me, who was present on the occasion. Perhaps, if I had merely this last person in my view, I should have been as little able to revive the meeting as with the first alone; whereas, with the two, I have no longer any difficulty.

The converse operation of remembering a person by two or more different connexions is still more frequently exemplified. A human being is a sufficiently many-sided object to be open to revival through a multiplex bond. Whether regarded as an aggregate of many parts, or as a concrete of many qualities, the remark holds to a great degree. The particulars of a personal description are very numerous, and it often requires many of them to be cited, in order to bring to mind an individual very well known to us. Moreover, the *external* relations of human beings surpass in variety those of other objects. Persons are associated with their name; with locality, habitation, and places of resort; with blood and lineage, a very powerful mental tie, in consequence of the strength of the family feelings; with associates and friends; with occupation, pursuits, amusements: with property and possessions; with rank and position; with the many attributes that make up character and reputation; with a particular age; with the time they have lived in; with the vicissitudes and incidents that mark the course of their life. Now, in recalling some individual to mind, some one or more of these connexions will serve; and when a present link is insufficient, others may be added. If we were endeavouring to recover the historical personages of a given time, the age of Pericles, for example, there would be a certain strength of bond between each of them and the idea of the time, namely, the fifth century before Christ. In the case of some, this link might be strong enough of itself; with others, a second link might be requisite, as for instance their profession. With the idea of a sculptor entering into the combination, we should recall Phidias; with a painter, Zeuxis; with a philosopher, Anaxagoras. Our historical memory is frequently helped after this fashion.

4. The connexion of things with *uses* is a source of multiple bonds. A tool, a building, the materials of food, clothing, &c., whatever comes into the market as a useful commodity, an army, or a fleet,—all such things have, besides their appearance, locality, ownership, &c., a distinct end to serve, whence arises a powerful bond of association. If I am

unable to remember the objects that I have seen in a certain shop, by virtue solely of their association with the shop, and with contiguous things that I do remember, one course open to me would be to run over in my mind a list of utilities to be answered, in which list I should bring up one or more uses of the forgotten things, and the new bond co-operating would be sure to recover some of those from their oblivious condition. To carry away a full recollection of the contents of a manufactory that I have visited, I should find it necessary to aid the associations of contiguity of place and succession with the various ends or utilities that were to be suited.

In the natural sciences, the material objects of the world are looked upon as having many *properties*, useful or not; these are ascertained by observation and experiment, and are recorded as part of the description of the several substances. In this way, everything suffers an ideal expansion or aggrandizement in the mind; the connexions of things, or the threads that give us our hold of them, are multiplied. The substance, silica, in the mind of a naturalist, has a vast range of associations in consequence of the many properties entering into his notion of it. These various links tend to bring the substance repeatedly before the mind; sometimes one link is sufficiently powerful, as for example, the recollection of a given degree of hardness; at other times, the material is recoverable by double or triple connexions, as the ideas of an oxide, of insolubility, and of a six-sided crystallization. The scientific man's memory is constantly aided by the multiplication of bonds individually too feeble to bring about the recollection of something absent. In invention, or in the search for a new device to answer some end, the mind must go over catalogues of objects according to many kinds of contiguity, including the most casual connexions.

5. *Successions.*—I have dwelt at length, in a previous chapter, on the contiguous association of successions of various kinds. Here, too, in the circumstance of imperfect adhesion, the recovery may be due to a composite action. I have witnessed a series of events, and these are, in consequence,

associated in my mind. In endeavouring to recall the series from the commencement, a link fails, until some other association, such as place, or person, contributes an assisting thread.

There is one succession that contains the whole of our experience, that is, the Order of Time, or the sequence of events in each one's own history. If all the minutiæ of this succession were to cohere perfectly in the mind, everything that we have ever done, seen, or been cognizant of, could be recovered by means of it. But although all the larger transactions, and the more impressive scenes, of our personal history, are linked in this order with a sufficient firmness, yet for smaller incidents the bond is too weak. I cannot remember fully my yesterday's train of thoughts ; nor repeat verbatim an address of five minutes' length, whether spoken or heard. Things related in the order of time are, strictly speaking, experienced only once, and we usually require repetition to fix any mental train. It constantly happens, therefore, that we are in search of some reinforcing connexion to help us in recovering the stream of events, as they occurred in the order of time. We seek for other conjunctions and successions to enable us to recommence after every break.

Experience teaches us, that the only way of making up a defective adhesion is to compass in our minds some other connexion, or to get at the missing object through a new door. The inability to recollect the next occurring particular of a train that we are in want of, stimulates a great effort of volition, and the true course for the mind to take is to get upon some chain or current that is likely to cross the line of the first near the break.

At every moment of life, each person stands immersed in a complicated scene, and each object of this scene may become a starting point for a train of recollections. All the internal feelings of the body ; everything that surrounds us and strikes the eye, ear, touch, taste, or smell ; all the ideas, emotions, and purposes occupying the mind ;—these form so many beginnings of trains of association passing far away into the remotest regions of recollection and thought; and we have it in our power to stop and change the direction as often as we please. From some one of these present things, we must commence our outgoings towards the absent and the distant, whether treading in single routes, or introducing composite action.

6. *Language.*—The recall of names by things, and of things by names, gives special occasion for bringing in additional links to aid a feeble tie. When we have forgotten the name of a person, or of an object, we are under the necessity of referring back to the situation and circumstances where we have heard the name, to see if any other bond of connexion will spring up. Often we are unable, at the moment, to recover the lost sound by any means; but, afterwards, an auxiliary circumstance crosses the view, and the revival is effected.

Many of our recollections, thoughts, conceptions, and imaginings, are an inextricable mixture of language and ideas of things. The notions that we acquire through oral instruction, or from books, are made up in part by the subject matter purely, and in part by the phraseology that conveyed it. Thus, my recollection of a portion of history is made up of the train of words, with the train of historical facts and scenes, as I might have seen them with my own eyes. So in many sciences, there is a combination of visual or tactual notions with language. Geometry is a compound of visible diagrams with the language of definitions, axioms, and demonstrations. Now, in all these cases, recollection may depend, either on the associations of words, or on those of visual and other conceptions, or on a compound of both. If I listen to a geographical description, there is, in the first place, a train of words dropping on my ear; and, by virtue of a perfect verbal cohesion, I might recall the whole description and recite it to another party. In the second place, there is a series of views of objects—of mountain, river, plain, and forest—which I picture in my mind and retain independently of the language used to suggest them. Were my pictorial adhesion strong enough, I could recall the whole of the features in the order that I was made to conceive them, and leave aside the language. The common case, however, is that the recollection is effected by a union of both the threads of cohesion ; the pictorial train is assisted by the verbal, and the verbal by the pictorial, as may happen.

COMPOSITION OF SIMILARITIES.

7. The influence of the multiplication of points of likeness, in securing the revival of a past object, is liable to no uncertainty. It is only an extension of the principle maintained all through the discussion of the law of similarity, that the greater the similitude, and the more numerous the points of resemblance, the surer is the stroke of recall. If I meet a person very like some one else I have formerly known, the probability of my recalling this last person to view is increased, if the likeness in face and feature is combined with similarity of dress, of speech, of gait, or of any still more extraneous points, such as occupation, or history. Increase of resemblance *extensively*, that is by outward connexions, has the same power as increase of resemblance *intensively*, in rendering the restoration of the past more certain. It might admit of a doubt whether four faint links of contiguous adhesion would be equal to one strong, but it would be against our whole experience of the workings of similarity, to doubt the utility of multiplying faint resemblances, when there was no one sufficiently powerful to effect the revival. At the same time, we must admit that much more is contributed to the chances of reinstatement by intensifying one point of likeness, than by adding new ones of a faint character. By raising some single feature almost up to the point of identity, we should do more good than could be done by scattering faint and detached likenesses over the picture. This, however, is not always in our power ; and we are glad to find, that, when the similarity, in any one particular, is too feeble to suggest the resembling

past, the existence of a plurality of weak resemblances will be the equivalent of a single stronger one.

On this view, I might set forth the workings of composite similarities, from the various classes of examples gone over in the preceding chapter. In all very complicated conjunctions, as, for example, a landscape, there may be a multiplication of likenesses, unable to strike singly, but, by their concurrence suggesting a parallel scene. Hence, in endeavouring to recall resembling things, we may proceed, as in Contiguity, by hunting out new collaterals, on the chance of increasing the amount of similitude, and, with that, the attractive power of the present for the absent. If I am endeavouring to recall to mind some historic parallel to a present political situation, supposing one to exist and to have been at some former time impressed on my mind, there may be a want of any single salient likeness, such as we admit to be the most effective medium of reinstatement; and I must, therefore, go over in my mind all the minute features of the present, to enhance, in this way, the force of the attraction of similitude for the forgotten parallel.

8. The case noticed at the conclusion of the preceding head, namely, the combination of language with subject-matter in a mixed recollection, is favourable to the occurrence of compound similarity. If an orator has to deal with a special point, the conduct of an individual, for example, which he wishes to denounce by a cutting simile, his invention may be aided by some similarity in the phrases descriptive of the case, as well as in the features of the case itself. If one who has at a former time read the play of Œdipus, now commences to read Lear, the similarity is not at first apparent, but long before the conclusion there will be a sufficient accumulation of features of similitude, in dramatic situation and in language, to bring Œdipus to mind without any very powerful stretch of intellectual force. So, in scientific invention; a fact described in language has a double power of suggestion; and if, by good luck, the fact has a likeness to some other fact, and the description resembles

the language that accompanied that other when formerly present to the mind, there is so much the more chance of the revival taking place.

MIXED CONTIGUITY AND SIMILARITY.

9. Under this head, there are several interesting examples.

If any one, in describing a storm, employ the phrase 'a war of elements,' the metaphor has been brought to mind partly by similitude, but partly also by contiguity, seeing that the comparison has already been made. The person that first used the phrase came upon it by similarity; he that used it next had contiguity to assist him; and, after frequent repetition, the bond of contiguity may be so well confirmed, that the force of similarity is entirely superseded. In this way, many things that were originally strokes of genius, end in being efforts of mere adhesive recollection; while, for a time previous to this final consummation, there is a mixed effort of the two suggesting forces. Hence Johnson's remark on the poet Ogilvie, that his poem contained what was once imagination, but in him had come to be memory.*

In all regions of intellectual exertion—industry, science, art, literature—there is a kind of ability displayed in taking up great and original ideas and combinations, before they have been made easy by iteration. Minds unable for the highest efforts of origination may yet be equal to this second degree of genius, wherein a considerable force of similarity is assisted by a small thread of contiguity. To master a large multitude of the discoveries of identification, a power of similarity short of the original force that gave birth to them,

* 'On Tuesday, the 5th July (1763), I again visited Johnson. He told me he had now looked into the poems of a pretty voluminous writer, Mr. (now Dr.) John Ogilvie, one of the Presbyterian ministers of Scotland, which had lately come out, but could find nothing in them.

'Boswell. Is there not imagination in them, Sir?

'Johnson. Why, Sir, there is in them, what *was* imagination, but it is no more imagination in *him*, than sound is sound in the echo. And his diction, too, is not his own. We have long ago seen *white-robed innocence*, and *flower-bespangled meads*.'

is aided by the contiguous bond that has grown up, during a certain number of repetitions of each.

10. A second case is, when a similarity is struck out in circumstances such as to bring the absent object into near *proximity* in some contiguous train. Thus, a poet falls upon a beautiful metaphor, while dwelling in the region where the material of the simile occurs. In the country, rural comparisons are most easily made ; on ship-board, nautical metaphors are naturally abundant.

If we chance to be studying by turns two different sciences that throw much light on each other, we are in the best position for deriving the benefit of the comparison. When we know the most likely source of fertile similitudes for some difficult problem, we naturally keep near that source, in order that we may be struck with the faintest gleam of likeness, through the help of proximity. A historian of the ancient republics cultivates a familiarity with all the living instances of the republican system. Now that physical science is largely indebted to mathematical handling, the physicist has to maintain his freshness in mathematics. It is not safe to trust to an acquisition of old date, however pertinacious the mind be in retaining the subject in question. The great discoveries of identification that astonish the world and open up new vistas of knowledge, have doubtless often been helped by the accidental proximity of the things made to flash together. For illustration's sake, we might suppose Newton in the act of meditating upon the planetary attraction, at the time that the celebrated apple fell to the ground before his eyes ; a proximity so very close would powerfully aid in bringing on the stroke of identification.*

* Dr. Pick, a public lecturer on Mnemonics, has suggested an aid to verbal memory, founded on mixed contiguity and similarity. If we are learning a string of unconnected names, we must trust to contiguous growth solely ; but, if it be allowable to arrange them at pleasure, Dr. Pick suggests that we should find out an order, such that each word shall have in it something in common with the following, or some pre-established connexion of meaning. Thus, he takes the French irregular verbs, and arranges them

THE ELEMENT OF FEELING.

11. We have already seen, under Contiguity, that associations grow up between objects and emotional states, whereby the one can recall the other—the object reviving the emotion, and the emotion the object. Anything, for example, that has been strongly associated with a disgust, is apt to recall the feeling at a future time.

This bond may be found entering into composite associations. In remembering some past object that has been linked in the mind with a certain emotion, the presence of the emotion will contribute to the recall. Athough not always sufficient of itself, this vinculum will often be found cooperating with others to effect the revival of an old recollection. While luxuriating in a state of agreeable warmth, we are easily reminded of former situations and circumstances where we were under the same feeling.

When the mind is immersed in any of the special emotions, as Terror, Anger, Tenderness, Beauty, objects connected with the emotion are attracted, while all others are repelled. In moods of tenderness, objects of affection rise by preference. If the mind is disposed to indulge in the irascible emotion, objects of anger and hatred find an easy opening, while others are shut out, although strongly suggested by other links of association. Something occurs to remind a person of a good deed performed to him by the object of his wrath; but the recollection is not harboured. When an emotion possesses the mind in anything like fury, nothing that discords with it can find a place, while the feeblest link of connexion is sufficient to recall circumstances in harmony with the dominant state.

in the following series:—(I give the English) sew, sit down, move, go, go away, send, follow, run, shun, &c. The previous connexion between the actions expressed by 'sew' and 'sit down' is obviously a powerful addition to the link of mere contiguity in utterance. Alphabetical arrangement (or Alliteration) gives a similar aid, although not so efficacious as the close alliance of meaning that occurs in the above series.

12. Hence in minds very susceptible to emotion, the more purely intellectual bonds of association are perpetually combined and modified by connexions with feeling. The entire current of thought and recollection is thus impressed with a character derived from emotion. When tender affection is indulged as a dominant feeling, the objects that rise from the past, no less than those engaging the attention in the present, are for the most part tinged with this feeling. A joyous temperament has its genial recollections; melancholy opens the door to a totally different class. The egotist is eager for any suggestions that connect themselves with self, and a slight contiguity or similarity will suffice to make these present. Poetic emotion, gaining possession of the mind, gives a select character to the images that recur from the past. A strong natural feeling of reverence accumulates a store of ideas of things venerable, and gives them precedence in the resurrection of thought.

This peculiarity has often arrested attention, and has been adopted as a theme both by poets and by philosophers. An intellectual and cultivated nature strives to maintain the ascendency of the intellectual associations over the suggestions of emotions. The dominion of reason is another expression for the same fact.

When a particular emotion is excessive in the character, not only can we readily predict the actions, we can almost read the thoughts of the individual. The anecdote of Burke's divination of the thoughts of Goldsmith, when passing a crowd collected by the feats of a mountebank, can scarcely be called extravagant as an illustration in point.

INFLUENCE OF VOLITION.

13. In many cases our recollection of the past is promoted by Volition; that is, we have some purpose or end in view which stimulates the activity of the system to bring about the recovery. I wish to recall the name of an object before me, to remember where I last saw a given person, to find a principle applicable to a case in hand. For a time, I fail in

my endeavour, but, by prolonged effort, I effect the desired recovery.

It is interesting to ascertain in what way the power of the will combines with the intellectual forces of reproduction. At what point does this influence operate? Can it augment a contiguous adhesiveness too feeble, or the attraction of a similarity too little marked?

The influence is indirect. There is no power of adding to the energy of the associating bond either of contiguity or of similarity, by a voluntary effort. The reproductions of the intellect are withdrawn from the control of volition. One thought cannot be made to succeed another, by mere will, as one movement of a limb may be made to succeed another. The modes of interference of a volition are as follows :—

(1.) In exciting the nervous system, so as to exalt the intensity of the mental processes. It is the nature of an end strongly felt, to stimulate and excite the whole frame of body and mind. Difficulty adds fuel to the flame. Under excitement, within bounds, everything we do is done with more vigour. The bodily efforts are stronger, the senses are more alive, the volitions are more intense, and the intellect shares in the stimulation.

(2.) Volition may govern intellectual attention, in the same manner as observation is influenced by our will. When many things are before the eye, some are observed, and the rest passed by. A strong liking for one object of the scene stimulates the movements that turn the gaze in that direction; as when an infant bends its eyes to the flame of a candle or to a familiar face. Now, I have already maintained a lengthened argument to show that, in the recovery of objects as ideas, when they are no longer present as realities, the same nervous circles and the same organs of sense and movement are occupied, that were occupied in the original perception during the actual presence. The ideal picture of a building is a series of impressions, sustained in the optic and the moving apparatus of the eye, and in the circles of the brain actuated at the time when we were gazing on the actual building. Wherefore, as we have the power to prolong our gaze at pleasure upon the real object, to turn from one part to another, to examine some points minutely and pass the rest over,—so when this building becomes a recollection, the same power of varying the inward gaze remains to us. We can dwell upon the outline, to the exclusion of the details, we can concentrate the attention upon a column or a cornice, we can indulge our recollection of the appearance of the material; in a word, we can deal with the idea, notion, or recollection, as we could with the reality. Volition is not crippled by the transition from the actual to the ideal; for the reason, as I conceive, that the same organs are concerned in both. If the objects of observation, when existing as ideas, were made to pass into a separate chamber of the mind, I should have a difficulty in comprehending how they could be reached by this voluntary control; because I look upon volition as existing only in connexion with the active organs, that is, with the muscular system. Even in the sphere of thought, the limitation holds. The same volition that rules the bodily eye, can rule the mental, because that mental eye is still not other than the bodily one.

Thus, then, volition operates in aiding the recovery of the past, through the power of directing and fixing the attention on any of the objects present to the mind at the time, to the exclusion of others. I remember one link of an otherwise forgotten chain: I dwell upon this link till it becomes more vivid itself, and thus acquires the power of calling up the rest. The object so selected is the one made intensely present, and thereby becomes the starting-point of the association. The idea that next comes up in the movement of reproduction, will be some associate, or similar, of this; just as the thing that we select for special observation out of a various array seen by the eye, will be the thing that will suggest the next idea that rises before the mind. We can, therefore, always give a *preference of attention* to one of the many objects that come up to our recollection, whichever is thus preferred being rendered the suggestive object; and, accordingly, the resuscitated trains will be those in accordance with the purposes or ends of the moment.

In difficult or laboured recollection, we have already seen that the chief hope lies in obtaining additional bonds of association. An effort of volition is the means employed. The effort consists in fastening the attention on various things within the view till these, one after another, are rendered suggestive of trains of ideas, some one of which perchance may have a connexion with the thing sought, and may supplement the deficient bond up to the full power of recall. In searching out a historic parallel, for example, we may suppose the power of similarity unequal to the task of evoking a proper instance. The mind then starts off in a train of contiguity over the field of history; which proceeds not by any voluntary power of commanding one fact to succeed another, but by directing the view on a starting point,—the age of Alexander the Great, for instance; with the attention fixed on him, the associated particulars of his time, so far as they have been made coherent, flow in of their own accord. This power of concentrating the attention on any part of a circle of notions present to the mind, like the power of directing the observation on some one aspect of a real scéne, appears to be the main function of volition in the resuscitation of the past.

THE SINGLING OUT OF ONE AMONG MANY TRAINS.

14. If I look at a mountain, there are many trains that I may be led into, by taking this as a point to start from. By contiguity, I may pass to the other mountains of the chain, to the plains and the villages beyond, to the mineral composition of the mass, to the botany, to the geological structure, to the historical events happening there. By similarity, I may be led away to mountains that I have seen in other lands, or in the representations of the painter and the poet, to the analogous geometrical forms, to equivalent artistic effects. All these vents may be open to me, but it will happen that I go on some one track by preference, and there will be a motive

for the preference. Perhaps one of the associations may have come by repetition to have greater force than any other; I may have been so accustomed to associate together the mountain and the neighbouring village, that I am led at once upon this one special transition. Another cause may be the presence of a second associating bond. If I see the adjoining mountain, I am then liable to be led along the chain; if I catch the glancings of the cascades, there is a double link of contiguity, tending to carry my mind to the river flowing from the sides of the mountain. If historical events have been recently in my mind, the events referable to this locality are suggested. If botany or geology is my study, a bent corresponding to these is impressed on the current of thought; if geometry, the forms suggested by preference are the figures of geometry; if I am an artist, the forms of art spring up instead.

The position supposed almost demands an additional and a specializing bond to set the mind in motion at all. We could imagine an intellectual situation so equally balanced, that no revival took place in any direction, just as in a conflict of equal volitions. Some *inequality* of restorative power in the various trains, or some second association coming in aid of one to give that one a preponderance, is the condition of our reviving anything. The case of an intellectual standstill between opposing suggestions is neither chimerical nor unexampled.

I will suppose another instance. A violent storm has flooded the rivers, blown down trees and buildings, and inspired general terror. The trains of thought suggested by such an incident are extremely various, and will depend on the mental condition of the observer in other respects, or on the special ideas that concur with the aspect common to all. The sailor's wife thinks of her husband at sea. The merchant and underwriter have their thoughts on the same element. The farmer calculates the loss to his fields. The millowner sees a prospect of abundant water power. The meteorologist studies the direction, duration, and force of the hurricane, and compares it with previous cases. The poet sees grand and imposing effects. The religious man has his mind carried upwards to the Deity.

These instances imply some *habitual attitude* of the mind, or an emotion, occupation, or pursuit, ever ready as a starting-point to the intellectual movement, and combining itself with every casual impetus given to the mental trains, so as to constitute an element of the composite effect. The principle is exactly the same in cases where the second association is present merely by accident.

15. We have more than once adverted to the mental aggregates, formed by the cluster of properties attaching to natural objects, especially as viewed by the scientific mind. Thus the idea of the mineral quartz is a vast assemblage of facts, properties, and influences, all which are liable to come before the view, when the mineral is seen or named. So even a naked circle is rich in associations to the geometrical mind. It does not therefore follow that, every time a mineralogist looks upon a piece of quartz, all its many qualities shall rise and pass before his view; or that every circle shall hurry the mind of a geometer all through the Third Book of Euclid. The associating links in both cases are good and sound; but some motive additional to the force of the acquired adhesions is needed actually to recover the train. Not only must the mind be disengaged from other trains, there must also be a positive stimulus, a second starting point, to individualize and determine the bent of the suggesting power to one or other of the many associated ideas. If I am handling a piece of quartz and trying a knife edge upon it, the degree of hardness of the mineral is the quality suggested; if an acid is at hand, the chemical action of quartz is brought up to the view, and so on. When one of the many properties of the circle strung together in the mind of a mathematician is resuscitated by preference, it is by the agency of some specializing notion pointing to that individual. The most opulent mind has moments of quiescence, and yet how numerous the possible outlets of thought at every moment!

OBSTRUCTIVE ASSOCIATIONS.

16. It will now be apparent that thoughts may fail to be suggested, notwithstanding an adequate force of association. We have had two remarkable cases in point; the influence of an emotion in keeping back what is not in harmony with it; and the necessity for an additional determining link where many lines of suggestion are equally open.

These are not all. A recollection is sometimes made impossible, through the mind's being inextricably seized with something near what is sought, but yet different. We are often in this state of embarrassment in remembering names. Falling accidentally into a wrong articulation, we are unable to get out of the coil; and it is not till some time afterwards, that we are even in a position to give a fair trial to the recollective adhesion actually present. So, a stroke of similarity may be effectually resisted, by the presence of something repugnant. The principle of compound association necessarily involves this efficacy to obstruct. If two ideas, by both pointing to a third, constitute a prevailing bond of restoration, it must likewise happen that if these two present ideas point in opposite directions, they will be liable to neutralize one another's efficacy. The power of assisting implies the power of resisting.

Both in the present chapter, and in speaking of constructive associations in the following chapter, it is open to us to remark the distracting influence of too many ideas. Promptitude of action is greatly favoured by the fewness of the considerations that enter into a question. Marvels of ingenuity are often accomplished through the absence of superfluous suggestions. In the operations of animals, happy efforts occur to surprise us, as being apparently out of keeping with the range of their faculties; in some instances, the explanation is found in the limitation of the views. The animal does not suffer from a crowd of incompatible associations. The same circumstance often explains the extraordinary facility of speech, or the readiness in action, of men very deficient in mental force generally. It is observed by philologists that our cultivated languages have ceased to form new roots. The reason is, that the existing roots stand in the way. Originality is everywhere arrested by the presence of a large stock of already-formed conceptions. Children, before learning the common-places, often give birth to original remarks.

17. Obstructive association may be traced, on a grand scale, in the conflict of different modes of viewing the objects and occurrences of the world. There is a standing hostility between the Artistic and the Scientific modes of looking at things, and an opposition less marked between the Scientific, or the Theoretical, and the Practical points of view. The artistic mind is obstructed by the presence of considerations of scientific truth; and the scientific mind, bent on being artistic, walks encumbered, and with diminished energy. Poetic fiction is never so brilliant as when the trammels of truth are set aside.

A good instance of the obstructiveness of incompatible ideas is found in the effort of guessing riddles and conundrums. These always turn upon the equivocal meanings of words. Now, a mind accustomed to dwell upon the real meanings of language is disqualified from following out the play of equivocation, not because the requisite associations do not exist, but because these are overborne by others inimical to the whole proceeding.

ASSOCIATION OF CONTRAST.

18. Aristotle's enumeration of the associating principles of the mind included CONTRARIETY, along with Similarity and Coadjacency. Various subsequent writers have likewise viewed Contrast as a primitive suggesting force of our intellectual constitution.

It is a well-known fact that objects do, on many occasions, bring before the mind their contraries. An intense light will suggest darkness or shade; present sorrows will bring up past joys; and a moment of brilliant prosperity may not be unfavourable to the recollection of times of adversity.

Contrast is the reproductive phase of the first law of mind—*relativity,* or Discrimination. Everything known to us is known in connexion with something else, the opposite or negation of itself: light implies darkness; heat supposes cold. Knowledge, like consciousness, in the last resort, is a transition from one state to another; and both states are included in the act of knowing either. Nothing, then, can be more natural, when we are considering any one property, than the disposition to revert to the other property which makes its contrast, or opposite—the thing denied when it is affirmed. 'Great' would have no meaning to us, would never have been named or marked as a quality, if we had not had before us things of unequal magnitude, whose difference or contrast affected our minds with a lively impression. The 'great' is great only because there is a something else 'not great,' or 'small'; even when we imagine we are looking at the single property greatness, we have in our minds by *implication* the alternative, smallness; and it is only like reversing the magnet, to pass to the *explicit* consideration of the alternative; in which case the other, 'greatness,' would be the implied property. This is what we do, when we pass from one member of a contrast to the other; both members must be present, although we make only one the explicit object of consideration for the time. That the other member is still before us in a manner, is shown by the fact that, if we have been long absent from the express consideration of the alternative, we become oblivious to the force of the principal. The effect of summer warmth continued for a length of time, is to diminish the sense of warmth; a few wintry days interpolated would revive the poignancy of the sensation. When a meaning is but dimly perceived by any one, the fault most frequently lies in the non-recognition of the opposite, that is, the thing to be excluded or denied, the supplying of which renders the notion luminous at once. Show a child a rod, and tell him that it is straight; you will probably convey no notion whatever to his mind; but present at the same time a bent rod, and say that it is *not* straight, but bent, and you impart a genuine cognition. Thus, then, whenever we have an object in our view, we have by implication the opposite; we can on the smallest motive reverse the couple, which is to pass to the contrast. Thinking of 'just,' with some definite meaning, we must have in the mind, only in a less prominent shape, the notion of some things that would be the reverse of just; and if we want to make the idea of the just more lively and definite still, we pass for a time to the explicit consideration of those 'not just' things, and then return to the other. An artist knows that contrast is the life of every effect. A scientific expounder is aware that to add the 'antithesis' or 'counter-proposition,' is only completing the statement according to the fundamental law of cognition; hence in him the 'association of contrast,' in the form of passing from the thing affirmed to the thing denied, is a settled habit.

19. But, farther, it is to be observed that the other powers of the *intellect*—Retentiveness or Contiguity, and Similarity—concur in some degree with the primordial principle of Relation in enabling us to pass from one thing to its contrast. Thus, as regards Contiguity, it happens that the greater number of contrasts are, in consequence of their necessary proximity from the nature of knowledge, habitually coupled together in common speech; whence we acquire a tendency to pass from the one to the other by mere rote, like completing a hackneyed form of words. Such associated couples as white and black, high and low, up and down, large and small, thick and thin, weak and strong, young and old, rich and poor, life and death, pain and pleasure, true and false,—are in everybody's memory; if one member is presented, the other is instantly ready to come up. Among our acquisitions of Contiguity, these contrasting pairs are very numerous. This fact alone would suffice to render contrasting qualities frequently suggestive of each other.

Next, as to Similarity. It is an old maxim, that contraries imply community of kind. Where there is nothing common, there can be no opposition. We oppose a long road to a short road, we do not oppose a long road to a loud sound. We can contrast black with white, because they agree in kind—they are both colours and modes of light. Thus it is, that, when any quality is present to the mind, the opposite quality never can be far off, seeing that this is only another species of the same kind of object. When we see any one gaily attired, the subject of personal decoration is brought before the view, and one variety of it suggests, by virtue of the generic agreement, other varieties, among which there may occur cases of squalor or meanness. So when we encounter a person of low fortunes, the subject of human conditions is present to the mind, and by Similarity other instances may be brought up, the first to occur being naturally those agreeing in the features of the present case, but not to the exclusion of cases with varying or even contrasting features. One member of a class may at any time suggest the remaining members, including the extremes. This is a case of the law of similarity.

20. We have farther to note the *emotions* frequently aroused by contrasts.

To take one class of examples. When any quality is present in a painful excess, the opposite quality is unavoidably suggested as a remedy to the evil. Darkness in this way causes a craving for light, and too much light impels us to seek the shade. So, cold and heat, hunger and repletion, exercise and rest, and many other things, operate in the same way.

Again, there is a strong emotion of the poetic or artistic kind, generated by many contrasts. We are moved by seeing infancy and age placed together; the still greater contrast of life and death has a solemnizing influence. In the fortunes of men and nations, we are struck with the conjunction of the high and the low, with the greatness that has emerged from obscurity, and the pride that goeth before a fall. This effect has been worked up in the poetic literature of nations. Among the Greeks, the idea of *nemesis* was an intense ever-present conception; even the accurate mind of Herodotus was superstitiously sensitive on this point. In no age has either the poet, or the moralist, allowed the reverses of human conditions to drop out of the view of the multitude. All the contrasts of this class are therefore disposed to be mutually suggestive to a very high degree.

Another striking example of the influence of emotion in determining the rise of thoughts, is furnished by the well-known feeling called the love of contradiction. The clear expositor of truth knows that contrast is a means of illustration, and is moved on that ground to pass from any given idea or proposition to the opposite; while the contentious disposition produces the same tendency to search out the contradictory of every affirmation that happens to be brought forward.

21. A better use of the reproductive power of contrast, is to impel us to unity and consistency in our opinions or beliefs. If we hear anything stated at variance with something formerly known or believed, we are likely to be reminded of the previous statement. If I have ever affirmed, or heard any one affirm, that the Homeric poems were the work of one man, and if now I am asked to believe that these poems were composed by several authors, I cannot help being reminded of the opposite view. In this way, the past and the present are confronted as effectually as if the opposites had been affirmed at the same moment, and we are thereupon urged, by the whole force of revulsion against inconsistency, inherent in our nature, to dismiss one or other of the conflicting opinions.

The power of Similarity, under the guise of Contrast, is thus able to rid the mind of contradictions, in so far as this can be done by bringing the conflicting opinions face to face. A present assertion revives any past assertion that may have been made on the same subject, and, if, the two are contradictory, an opportunity is given for choosing between the two.

It happens, however, in fact, that the same mind will at different times maintain irreconcilable propositions unawares. Either the power of reinstatement by similarity is too feeble, or there is some strong feeling at work that repels the approach of any fact not in accordance with the view held for the time being. Both causes are found at work. In an average intellect, the power of similarity is not energetic enough to search the past for all the statements that may have been made upon any subject now in hand ; and many inconsistencies are too subtle for the detection of an ordinary mind. When we add to this intellectual feebleness the power of emotion,—the influence of the likings and dislikings,—we have a sufficient explanation of the co-existence of contradiction in the same mind. It has been already observed, that a strong feeling will rebut all ideas incompatible with itself, however strongly they may be suggested by the forces of association. I can suppose the Apostle Peter to have been unconscious of contradicting himself within a few hours, when under excitement for his personal safety. The strong affirmations he had so lately made on the very same subject might not even have come into his mind. A current of violent emotion, besides overbearing hostile considerations that may be actually before the mind, can so obstruct, I might almost say paralyze, the workings of association, that such considerations, however near, shall not be allowed to come on the stage. This is one of the characteristic influences of emotion. Intellect cannot perform its ordinary functions in the presence of strong feeling. The accordance or discordance of objects and recollected ideas with the present emotion, is so powerful that the purely intellectual links may have but a small share in the resuscitation. The tendency of intellect proper is to banish all contradictions from the mind, in other words, to arrive at consistency, the test of truth : the tendency of men's emotions of all kinds runs counter to this, and renders the spectacle of a thoroughly consistent human being no less rare than admirable.

CHAPTER IV.

CONSTRUCTIVE ASSOCIATION.

By means of Association, the mind has the power to form *new* combinations, or aggregates, *different* from any that have been presented to it in the course of experience.

1. THROUGHOUT the whole of the preceding exposition, we have had in view the literal resuscitation, revival, or reinstatement of former actions, images, emotions, and trains of thought. No special reference has been made to the operations known by such names as Imagination, Creation, Constructiveness, Origination; through which we are supposed to put together new forms, or to construct images, conceptions, pictures, and modes of working, such as we have never before had any experience of. Yet the genius of the Painter, the Poet, the Musician, and the Inventor in the arts and sciences, evidently implies a process of this nature.

Under the head of Similarity, we have had to recognize a power tending to originality and invention, as when—in virtue of the identifying of two things lying far apart in nature—whatever is known of the one is instantly transferred to the other, thereby constituting a new and instructive combination of ideas. Such was the case when Franklin's identification of electricity and thunder, led to the application of the Leyden jar to explain a thunder-storm. The power of recalling like by like, in spite of remoteness, disguise, and false lures, enters, as we have seen, into a very large number of inventive efforts, both in the sciences and in the arts. But we have now to deal with constructions of a higher order of complexity. There are discoveries that seem nothing short of absolute creations, as, for example, the whole science of Mathematics; while, in the Fine Arts, a frieze of the Parthenon, a Gothic cathedral, a Paradise Lost, are very far beyond the highest stretches of the identifying faculty taken by itself.

Nevertheless, the intellectual forces operating in those creations, are no other than the associating forces already discussed. The new combinations grow out of elements already possessed by the mind, and brought to view according to the laws above laid down.

MECHANICAL CONSTRUCTIVENESS.

2. In our mechanical education, complex and difficult actions are acquired by taking the simple acts separately. We learn part No. 1 by itself; then part No. 2, No. 3, and the rest; when each of these parts is attained, an effort of *volition* joins them together.

Mechanical combinations are usually formed by successive additions. A certain movement is mastered; another is entered on by itself, and when mastered is added to the first. In military drill, in learning to manipulate, or to dance, each step is practised alone; when two have been attained in separation, they can be performed together, merely by willing it. A third and fourth are added in the same way. There is no new difficulty in grouping or combining the distinct operations. Any awkwardness in the united effort is mainly owing to the separate parts not being fully confirmed.

Our mechanical acquirements often demand the *suppression* of one member of a complex action, a decomposition, as it were, of some of the primitive associated movements. In this case, a voluntary effort is directed upon the member whose movement is to be suppressed. In walking, there is a natural tendency to swing the arms and the body along with the lower limbs. By a volition, these extra movements may be arrested, and the primitive aggregate reduced to a more select aggregate.

Learning to swim is a good example to show what remains to be done in mechanical combination, after the separate acts are fully mastered. The beginner includes among previous acquisitions the voluntary control of the arms, and of the lower limbs. Perhaps, indeed, this control needs to be improved as respects the swimming movements : accordingly, the first thing is to practise the separate acts of throwing out the arms and the legs. The next thing is to bring them together, in the proper rhythm or combination. There being, however, a certain delicacy of adjustment, the pupil does not succeed at the first attempt. Various tentatives are made ; and at last, by chance, the rhythm is hit upon, and, being hit upon, is persisted in. The moment of a successful achievement, after struggles, is singularly favourable to the cohesive process, according to the law of awakened and concentrated attention ; and the happy combination is already cemented to such a degree, that fewer tentatives are required on the second occasion. By two or three more repetitions, the fusion is complete.

In the full detail of Constructiveness, we shall have to exemplify these three main conditions :—namely, (1) a previous command of the elements entering into the combination ; (2) a sense of the effect to be produced ; and (3) a voluntary process of trial and error continued until the desired effect is actually produced.

VERBAL CONSTRUCTIVENESS.

3. The facility in passing from mere iteration into new combinations, is perhaps most obvious in the use of language. Few successions of words of any length, uttered in everyday intercourse, are precisely the same as any succession formerly said or heard by the speaker. Yet we find it easy to adapt the old to new purposes.

In the early efforts of imitation, whereby words are first mastered, there is a constructive process. The child has learned to say *ba* and *na*, and when these separate sounds become very easy to the organs, a chance impulse makes them run together into *ban*. Here, as before, the ripeness of the preliminary acquirements separately, is the first condition of a successful union.

After acquiring a certain number of words, and a few simple forms of sentences, new forms are produced. The child has learned to say 'give me,' and also the names of a number of other persons and things, 'mamma,' 'pussy,' 'dolly'; and having the wish to give something to one of these, finds no difficulty in displacing 'me' from the formula, and admitting 'mamma,' 'pussy,' as the case may be. An effort of volition is implied. Two utterances are present to the mind; the articulate activity is awakened, and repeats these utterances perhaps in two or three ways; one is hit upon, such as to satisfy the purpose of the moment, and, being hit upon, is retained and repeated. The effort of substitution, once or twice put in practice, becomes easy; the mind knows as it were to carry on the current of words so far, then to stop, and to fall into a different current, so as thereby to produce a third, different from either. It is a part of the voluntary command of our movements, to stop a sequence at any stage, and to commence another train from that point; which is all that is necessary in the case supposed. Out of the two sentences, 'I am going out for the day,' 'I am coming home for the night,' a third sentence is constructed, 'I am going out for the night,' by no further effort of volition than this, namely, to arrest the current of articulation at a certain point in the first, to pass into the second, suspending vocal articulation till the word 'the' is reached, then to tack on the remainder, 'night,' to the words already enounced from the other. The constructiveness, therefore, lies not in any purely intellectual operation, but in the command that the volition has obtained over the movements, by virtue of which command, these are suspended and commenced at pleasure, in the service of a particular end. The intellectual forces bring to mind the former acquisitions bearing on the situation, and if no one previous form is strictly applicable, the volition singles out part of one and part of another; and makes successive trials, if need be, until the want is satisfied.

Throughout the whole wide-ranging operation of adapting old forms of words to new meanings, this is essentially the process pursued. When all the elements requisite for a new combination are at hand, a volition alone is needed to make the selection and adaptation suited to the end in view. When there is not a sufficiency of forms within reach of the present recollection, the processes of intellectual recovery must be plied to bring up others, until the desired combination is attained. A voluntary effort is quite equal to the task of cutting down and making up, choosing and rejecting, sorting and re-sorting; *the feeling of the end to be served* is the criterion to judge by, and when this is satisfied, the volition ceases, the stimulus being no longer present. In all difficult operations for purposes or ends, the rule of 'trial and error' is the grand and final resort.

It would thus appear, that the first condition of verbal combinations for the expression of meaning, is a sufficient abundance of already formed combinations to choose from; in other words, the effect depends on the previous acquisitions, and on the associating forces whereby old forms are revived for the new occasion. If a complex meaning has to be expressed, every part of this meaning will revive, by contiguity and similarity, some former idea of an identical or like nature, and the language therewith associated; and out of the mixed assemblage of foregone phrases, the volition must combine a whole into the requisite unity, by trial and error. The more abundant and choice the material supplied from the past by the forces of intellectual recovery, the better will be the combination that it is possible for the mind to form by the selecting effort.

4. Let us next advert to some of the higher conditions that have to be attended to in making verbal combinations. Besides conveying a meaning, certain grammatical forms have to be observed; likewise, there are rhetorical properties or rules of good taste; a certain melody or cadence is sought to be

imparted; and, in poetic composition, the other qualities have to be attained under the restrictions of metre and rhyme. As a matter of course, the more numerous the requirements, the more difficult it is to satisfy them all; but the mode of proceeding is not altered in any essential point. When there are four or five different conditions to satisfy, the range of choice must be so much the wider. It is not enough that I can combine one form of words sufficient to express a certain meaning; I must be able from my verbal resources, recovered from the past, to construct several forms all equally good as regards meaning, so that I may be able to choose the one that satisfies the other conditions as well. In fact, the mind must possess, not one way of bringing out a certain effect, but a plurality of ways, and, out of this plurality, we fix upon the form that yields some second effect also desired. If a third effect is wanted, there must be a power of altering the combination already made, without losing those already gained; and for this end, we must be able to command a choice of equivalent phrases, in the room of those that are discordant as regards the new end.* Thus it is that we must have a plurality of ways of expressing any given meaning, a plurality of forms of the same grammatical construction, a plurality of forms of the same rhetorical propriety, and a great variety of sequences observing the same cadence. Through such opulence of synonyms, we, at last, light upon a combination that satisfies all the requirements of the case. The refusal to combine in any instance can be met only by bringing forward new varieties of phrase, sometimes by the bond of meaning, at other times by the bond of grammar, of taste, or cadence. The more richly stored the mind is on any one of those particulars; that is, the greater the number of words associated with meanings, with

* Southey's lines on the Fall of Lodore are an instance to show that a word-artist is a person that can bring up for any occasion a large variety of names for the same thing. It is by means of this abundance of past and recoverable phraseology, that the elaborate constructions of high composition are at all possible. The number of words that pass across the mind in forming a single couplet, may be a hundred times those actually made use of.

melodious cadences, and so forth, the more surely will that one condition be observed, whatever may become of the rest. If the tendency has been to lay up stores of expressions adapted to the conveyance of meaning, there will be no difficulty in matching a new meaning, although there may be a difficulty in getting the language to comply with the other requisities. If, on the other hand, through a great susceptibility to cadence, and by the mind being very much versed in melodious forms of speech, these forms be ready to occur in great abundance on all occasions, the flow of speech will be sure to be musical, but there will be no security for the fulfilment of the remaining conditions ; and it may happen that both sense and grammar are neglected. Still, out of the abundance of choice presented by this acquisition, a patient mind may seize upon forms that shall not be devoid of any of the other important attributes. Or, if the first suggestion of the wording of a sentence is governed by associations with meaning, it will be easy for such a mind to make substitutions and alterations to meet the rhetorical condition.

FEELINGS OF MOVEMENT.

5. We next proceed to exemplify constructiveness among our feelings and ideas.

Movement gives rise, as has been seen, to a variety of conscious states ; some emotional, as the states of exercise and repose, and others with an almost exclusively intellectual character, as the feelings of pressure, space, and form. I shall here take a few examples of the second kind.

Having acquired a discriminative sensibility corresponding to some one resistance or pressure, we are enabled to construct the feeling of another differing in degree. I possess in my hand, after much practice, the engrained impression, say, of a pound weight ; and I am commanded to construct, conceive, or imagine, the impression corresponding to three pounds. For this end, I must endeavour to fuse the two notions of one pound and of a triple, being formerly very familiar with both in their separation; the notion of tripleness being derived from my experience of the fact in quantities of various kinds. By keeping my attention very much bent upon the two elements in question, I may succeed in conjuring up an impression compounded of both, and corresponding more or less to the actual feeling of a three-pound weight in my hand.

We are not unfrequently called upon to make efforts implying this sort of adaptation. If I have been accustomed to jump a ditch three feet wide, I can easily increase the notion for an effort of five feet. So in throwing objects to hit a mark; in which case, the constructiveness is first operated upon the pre-conceived *idea* of the action, before passing to the action itself.

The same power of changing degree may be put forth in reference to size and form. Having acquired the arm-sensibility to a sweep of one foot, we can construct a feeling corresponding to the sweep of two feet, or half a foot. We can also change a given area from one form to another. By fixing the mind upon the form of a circle, and the area of a square pane of glass, we can construct the conception of a round piece whose diameter is the side of the square.

The demand for certain Architectural proportions in buildings supposes an effort of the constructive faculty, applied to the muscular feelings of weight and resistance. By moving and lifting pieces of stone of small size, we acquire a certain estimate of the inertia and gravity of the material; an estimate that we extend constructively to large blocks, which we cannot directly manipulate. By multiplying known feelings of muscular expenditure, we conceive, perhaps inadequately, the weight of a solid stone lintel; and by similarly multiplying our experiences, on the small scale, of the tenacity of stone, wood, or iron, to resist pressure,—we pronounce upon the sufficiency of two props, of stone, of wood, or of iron, to sustain that lintel. Such is our feeling of Architectural fitness, or of the beautiful in support.

The emotional feelings of movement present a somewhat different case. Under the two next heads, I shall adduce examples of emotional constructiveness in general.

CONSTRUCTIVENESS IN THE SENSATIONS.

6. Beginning with Organic sensibility, we might cite instances of constructiveness, in the endeavour to conceive pains or hurts of a different kind from any we have experienced. We can, as usual, make the change of degree ; and, if the new state is either a combination, or a disjunction, of two already familiar to us, we may hope to succeed in evoking it.

The agreeable and joyous states of organic sensibility are very various. Each one of us has experience of some of them : and, starting from these, we may be made to conceive others, if the description, that is, the method of compounding the known into the known, be clearly given. I may never have experienced the ecstasy of intoxication by opium, but if I have felt a number of states whose combination would amount to this effect, and if these are pointed out to me, I can, by an effort, recall and fuse them into one whole, so as to construct the feeling in question. This is by no means an easy undertaking to the generality of people ; and the reason is, that the strong organic feelings are not readily recoverable at all times in their entire fulness. Some one leading element of the combination sought would require to be present in the reality, and then it might be possible to bring up others, and to form a new conception, by introducing the requisite modifications. But, on the other hand, this method has disadvantages ; it is not easy to modify a strong and present reality by mere ideas ; it would be more practicable to modify a mere recollection, which is itself ideal. The non-intellectual nature of the organic feelings, rendering them stubborn to recall, however powerful they be in the actual, is the great obstacle to our easily conceiving non-experienced varieties of them. A person may have enjoyed the pleasures of eating, in a sufficient number of forms to possess all the elements necessary for conceiving the most luxurious feast that ever man sat down to, yet it may not be possible to attain to the conception. The difficulty of forming new combinations, in some one region of sensations, is only another form of the difficulty of retaining and recovering our own experiences in that region. If I cannot easily conceive a degree, or kind of hunger, beyond anything I have ever known, it is because the states of hunger that I have actually experienced, cannot be well restored after they have completely passed away.

Inasmuch as Tastes, properly so called, are somewhat more intellectual than organic states, we can do more in the way of forming new combinations of them. Given a bitter, such as bitter aloes, and a saline taste, as of common salt, we might construct a taste combined of the two. So a sweet and an astringent might be fused. We might thus attain to the conception of tastes not actually experienced. The effort would doubtless be laborious in most instances, owing to the imperfect recollection that we have of tastes, even after much repetition. A person specially educated in tasting would have so much the less difficulty. And if we wished to retain and revive the new conception, and to make it a possession of the mind, as much so as the taste of sugar, we should need an amount of repetition sufficient for the ideal coherence of the elements brought together.

7. Without dwelling upon the almost parallel case of smells, I shall pass to the first of the intellectual senses. Touch, including the muscular feelings associated with the proper tactile sensibility, furnishes a more abiding species of recollections than the sensations just noticed, and we may therefore look for a higher degree of combining power among the feelings characteristic of this sense. I can acquire the touch of an orange, that is, the bulk, the weight, and the softness of the surface. I have acquired also the touch of a marble table, and the weight of marble as compared with other substances. By a voluntary exertion of the mind, directing the view on the round figure of the orange, and on the touch and specific gravity of the marble, I can make

to emerge a new conception—the collective impression of a marble ball equal in size to the orange. Part of the difficulty, in this trial, consists in the *disassociating* or separating of elements that have grown together in the mind; an exercise commonly spoken of as an effort of abstraction, or *analysis*, and arduous, on the one hand, according to the strong hold that the property to be disassociated has taken of the mind, and, on the other hand, according to the weak hold that we have of the property to be substituted. If I were very strongly affected by the peculiar soft touch of the orange, and had very little interest in the cold hard contact of the marble, there would be a repugnance in my mind to the proposed transmutation; and the effort of abstractive, or analytic, volition, preparatory to the new combination, would be severe. A mind sensitive to the warm and sensuous elements of touch and colour, revolts from the operation, so familiar to the mathematician, of stripping these off, and leaving only naked forms and arbitrary symbols to engage the intellect. The double decompositions illustrated by the above example, are made laborious, by every circumstance that favours in the mind a preference for the combinations already existing, and correspondingly easy, when there is a partiality for the new combination that is to be the result. Thus, even when we operate upon subjects very conceivable and retainable, unlike the organic sensations lately noticed, new difficulties may arise to clog the constructive operation. The mere effort of analysis is itself something considerable; it is not a favourite avocation of the untutored mind, with which associative growth is more congenial than disassociating surgery; and when the analysis has to be applied to break up favourite combinations, and constitute others of an unattractive kind, we become aware of the tyrannical influence that the likings and dislikings, the sympathies and antipathies, exert over the intellectual processes.

The very great difference between the constructions of Imagination, and the combinations for Practice or for Science, is herein faintly shadowed forth.

In the definition, or description, of the tactile quality of surfaces,—woods, cloths, minerals, metals,—reference must be made to touches familiar to us, by whose combination we are supposed to attain the feeling of a surface not experienced. Touch is one of the defining properties of minerals.

8. In the very various states of mind excited through the sense of Hearing, there is wide scope for new combinations and constructions; the mode of operating being much the same as in the preceding instances. We may hear a note, or an air, sounded by an instrument or voice, and may wish to imagine it on a different instrument or voice. If we have a good mental grasp of the air, and of the tones of the second instrument, this transference may be effected after a certain amount of effort. We have heard a piece performed on a fine band; and we desire to conceive the effect of some other piece performed on the same band. Some faint notion of the result of such a combination might be attained, but the exercise is not one that is much attempted. Few people engage in an occupation of this nature, or endeavour to create to themselves non-experienced impressions with an approach to the vividness of reality.

'Imagine Macready, or Rachel, delivering that passage.' We have heard the passage, and we have heard Macready. A constructive effort, taking place upon firm recollections of the two things to be combined, might be successful in such an instance. A good imitator, or mimic, actually succeeds in modifying his recollections of his original to suit an entirely new discourse. The ability to make the combination, as in all other cases, rests in the first instance on the full possession of the separate elements.

9. Under Sight, the sense of easy conception by pre-eminence, the examples of constructiveness are extremely copious. Light and shade, colour, lustre, visible size or dimensions, shape, distance, position,—are the constituents that unite in the complex perceptions of sight; and it is possible to vary any given combination, by putting out and taking in elements at pleasure. I see or remember a line of

houses; I can imagine it prolonged to double or triple the length; or I can transform the whole line by the addition of a story to the height. In the landscape I see a mountain and a wood standing apart; I place the wood upon the mountain. Or to take Hobbes's example of constructiveness:* I have the idea of a mountain and the idea of gold, and by superimposing the one upon the other, I can evoke the image of a mountain of gold. The facility in all such cases, depends, as usual, on the perfect and easy command the mind has of the separate ideas, owing to their good ideal persistence. The combination takes place of its own accord, if the elements are once properly brought together and kept, as it were, in close contact for a sufficient time. A continuance of the effort will enable us to retain the new image, until the parts of it acquire a certain contiguous adhesiveness, after which we shall possess it as a mental recollection not differing essentially from the recollections of things actually seen. As in former examples, the decomposition and recomposition, implied in the constructive effort, may be aided or thwarted by emotions. Hobbes's mountain of gold would emerge the more readily that the image is one to excite men's feelings, being an example of imagination in the more limited sense of the word, or in that sense wherein lies the contrast between it and the creations of the intellect for scientific or practical ends. If I see a dress, and want to conceive it of some other colour, I can most easily substitute either the colour that I am most familiar with, or the one that I have a special affection for.

* 'As when the *water*, or any liquid thing moved at once by *divers* movements, receiveth *one* motion compounded of them all; so also the brain, or spirit therein, having been stirred by *divers* objects, composeth an imagination of *divers* conceptions that appeareth single to the sense. As for example, the sense showeth at one time the figure of a *mountain*, and at another time the colour of *gold*; but the imagination afterwards hath them both at once in a *golden mountain*. From the same cause it is, there appear unto us *castles* in the *air*, *chimeras*, and other monsters which are *not* in *rerum naturâ*, but have been conceived by the sense in pieces at several times. And this composition is that which we commonly call *fiction* of the mind.'—*Human Nature*, chap. iii., § 4.

The re-disposition of the parts of an interior, or a scene, severely tests the constructive faculty. Wishing to re-arrange the furniture of a room, I endeavour to conceive beforehand the effect of a proposed arrangement. So with a garden; a person must have a good retentiveness of the ideas of the parts, in order to put together, and hold firmly, the new plan, so as to judge of the effect of it before taking any measures to realize it. An intellect naturally pictorial, or disposed to retain visual images in general, and an education in the particular subject operated upon, are the requisites for success in such an operation. The susceptibility to beauty, or to the emotional effects of the several combinations, operates in favour of every construction that yields the emotion.

CONSTRUCTION OF NEW EMOTIONS.

10. We may revive emotional states by contiguity or by similarity, or by a composition of associating bonds; and, from two or more states thus revived, new emotions may be generated by constructiveness. I have already touched upon this, in speaking of the organic sensations, these being almost purely emotional in their character. But if we pass to the feelings that are more recoverable and more retainable in the ideal form, we shall obtain examples of greater frequency in actual occurrence.

The problem is to realize emotions such as we have never experienced in ourselves, or have experienced too rarely to recall them by any effort of mere recollection. The feelings belonging to men whose character, position, occupation, &c., are totally different from our own, can in general be conceived only through a constructive process, operating upon feelings that we do possess.

There are certain elementary emotions that belong to human nature in general, although manifested very unequally, in consequence both of primitive differences of character, and of variety in the outward circumstances of individuals. Every one has experience of wonder, of fear, of love, of power, of anger, of vanity, of remorse. Should any one of the elementary feelings be absent from a character, no constructive process is sufficient to create it; what constructiveness can produce is by that very fact not elementary. If, for example, a person were naturally devoid of the emotion of fear, this emotion could not be generated by any known effort of construction. In like manner, the irascible feeling seems so distinct and peculiar that we could not be made to conceive it without direct experience. Even when an emotion not entirely wanting is yet allowed to sleep, the difficulty of rousing it may prove insuperable; thus it is, that some men are unable to enter into the sentiment of religious veneration, and others are disqualified from comprehending the pleasures of the fine arts; one class are utterly incapable of sympathizing with the pursuit of scientific truth, and another can never be made to understand the feeling of disinterested usefulness.

The emotions that can be acquired by constructiveness are, therefore, the *compound* emotions, or some conceivable varieties of the elementary. We must be able in each case to specify certain primary feelings possessed by the person appealed to, the combination of which in a particular way shall yield the emotion that we desire to communicate or evoke. If the constituent elements are actually made present to the mind in their proper degree, the fusion will take place as a matter of course. Perhaps the best commencing exercise in this art of conceiving other men's feelings, would be to change the degree of one of our own emotions. I have a certain disposition to take on fear. It being, however, apparent that another person, whose character I am desirous of realizing, is susceptible to a much greater extent, I must endeavour to assume for a time a pitch of terror much beyond my own. This can be done in various ways. I may go back upon times of my life when the emotion took a greater hold of me; I may conceive occasions and circumstances of a kind to produce a more than ordinary degree of the state; or I may revert to the particular subject that most easily depresses my courage. Or, again, instead of working upon the emotion itself, I may exert my imagination to construct objects of intense and overpowering terror, from whose contemplation a high pitch of the feeling would arise. By these means I can be made to assume an unwonted amount of the feeling, and can approach to the state of mind of the person supposed, so as to foreshadow the actions flowing from that particular state.

By such endeavours, one might acquire an exalted cast of any familiar emotion. The exercise would cost both effort and time, but if we are able to revive with ease the past states of our own experience that bear on the case, we shall not be long in accomplishing the end in view. To acquire a new degree of intensity of any emotion so thoroughly, as to be able to follow out all the influences and consequences of the feeling, is a very high effort, and demands iteration and time; inasmuch as there is implied in it the process of fixing, into a permanent possession, a state of mind that has been worked up with labour. Thus, for the man that is only alive in a moderate degree to the pleasure of music, to be able, at any time, to rise to the state of an enthusiast, so as to depict that character in all its phases, there would be required a somewhat laborious training. Writers whose province it is to trace out and depict all the windings of characters different from their own, must work themselves into a number of unexperienced degrees and modes of feeling, as a preparation for their task.

11. The exercise of combining two emotions, so as to bring out a third different from either, is not intrinsically arduous. Everything depends upon the facility of assuming the elementary feelings. If a person has ever known an affection of the nature of a passion for any one object, such an one is capable of conceiving, by an effort of transference, a passion for an object very different. Thus it is that Michelet, in endeavouring to pourtray the attachment of the French peasant proprietor for his land, brings into the picture the feelings of strong personal attachment. The

difference of subject is great, but the attempt is not therefore hopeless. It would doubtless be much easier to transfer the feelings of love, in one personal relation, to some other relation, by making allowance for the difference, as in passing from friendship to marriage, or to the parental relation.

The historian, who has to deal with extinct modes of feeling, and who has to study truth in his delineations, is necessarily much versed in the exercise now under discussion. Mr. Grote forewarns his reader 'that there will occur numerous circumstances in the after political life of the Greeks which he will not comprehend unless he be initiated into the course of their legendary associations. He will not understand the frantic terror of the Athenian public during the Peloponnesian war, on the occasion of the mutilation of the statues called Hermæ, unless he enters into the way in which they connected their stability and security with the domiciliation of the gods in the soil.'—*Hist. of Greece*, Preface.

CONCRETING THE ABSTRACT.

12. Under a former head, I have supposed the case of fusing the properties of two different objects so as to make a third different from either. Given a brick city and a marble surface, to conceive a marble city. This is to form a new concrete out of two pre-existing concretes. But we may go a step farther. Given the abstract properties, to construct the concrete whole. Take, for example, the geometrical form of a pyramid and the colour of granite, and conceive the actual object as existing in nature. This is, in most cases, a somewhat more difficult operation than the foregoing, but can hardly be said to involve any new or distinct effort. If we realize the constituent elements with sufficient vigour, and keep the two together in the mind, the construction is sure to follow. If we have but a feeble hold of one or other of the parts, some exertion will be requisite to make them fall into their places in the new compound.

When the plan and sections of a building are given, we have the means of realizing the form of the solid building;

when we add the colour of the surface, or the appearance of the material to the eye, the concrete emerges in all its fulness. In this case, the plan and sections would not be enough to give the full solidity, unless we had previously seen solid shapes. We require to fasten upon some remembered building or form of building, and to alter this in the mind, till we bring out a correspondence between it and the plan supposed. Thus, in order to realize a gothic church from a builder's designs, the easiest way would be to direct the view upon some church already familiar to us, and on that to make the alteration prescribed by those designs. This is a general maxim in concrete realization, and by it we can easily understand the conditions that render the operation easy. It is evident that a previous store of well fixed objects of the particular kind in question, is the great requisite. If the past experience of the individual has given great opportunities for laying in such a store, and if the mind is naturally of a pictorial and concrete order, the process of new construction has every advantage in its favour. Not to speak of the chance of possessing firm and recoverable ideas of objects approaching *very near* the new construction, there is a great facility in making the required alterations, if the thing operated on is vividly and easily held in the view; provided always, that there is no serious obstruction from the feelings.

To imagine a country from a map is a case of the same nature. The effort consists in holding before the mind's eye a series of scenic views, in all the richness of the colouring, and all the fulness of the details, while performing the operation of cutting out and taking in, so as to suit the prescribed outlines. An intellect rich in concrete, or living, conceptions of actual nature possesses the prime requisite for such a task.

The mode of describing the objects of natural history is to enumerate the abstract properties. Thus a mineral is described by such abstractions as crystalline form, hardness, nature of surface, colour, lustre, &c. Now, by a vigorous effort of constructive conception, one might realize an actual specimen from the assemblage of abstract qualities. So with a plant or animal. The first condition of success is still the same. The mind must be well versed in actual specimens, so as to be able to lay hold of some concrete recollection, by operating upon which, a new specimen will emerge possessing all the properties of the description. A botanist can readily form to himself the picture of a new plant from the botanical description; a person less familiar with plants would find the construction laborious, perhaps impossible.

13. The more we analyze or decompose concrete objects into the abstract qualities that make them up, the more difficult is it to remount to the concrete. Hence the most arduous attempt of all is to make actual nature rise up out of scientific and technical language,—to conceive minerals from a book of mineralogy, and the parts of the human body from anatomical description. This is the repulsive or unfavourable side of science and of abstract reasoning. On the other hand, it is by the process of resolving natural aggregates into their ultimate abstractions, that we obtain the means of making new constructions widely differing from, and superior to anything that exists in our experience, by which many important ends in human life are furthered. New creations of science, and new devices of industry, result from this power of re-constituting the ultimate abstract elements of existing things. Even the artist will find his account in it, although it is not usual with him to carry abstraction so far as either the man of science, or the man of practice. Many great poetic conceptions are the embodiment of an abstract idea. Milton's personification of the spirit of evil may be quoted as an example.

REALIZING OF REPRESENTATION OR DESCRIPTION.

14. What is to be said on this head is little else than an application of the remarks already made. When we are desired to conceive an object differing from any that we have ever known, we can do so only by constructing it out of qualities and particulars indicated in a representation or description. The machinery of representation for such an

end is known to be very various; including pictures, sculptures, models, diagrams, and, greatest of all, language. If we wish to conceive a living human face by means of a coloured portrait, we require an act of constructiveness to make up the difference between the painting and the reality; we must fuse or combine a living face with the features of the portrait, till the one is completely adapted to the other. The difficulty lies in separating the suggestive part of the picture from the gross total of canvas and colour; and the labour is greater according as the painter has attempted to produce a work of art, that is, a pleasing combination of colour and forms. There is here that effort of analysis, which I have already alluded to, as the preliminary of many constructions, rendering them often very hard to accomplish. The same remarks apply to sculpture. An unartistic model (or wax image) is the best medium for enabling the mind to rise to the living and actual reality.

15. Verbal description is the most universal mode of imparting to the mind new ideas and combinations; and the hearer or reader must exercise constructiveness to realize the intended image. The one method of procedure open to the author of the description is to compose the unknown out of the known; the hearer must then implement the process by the force of his own mind, bringing together the suggested particulars into a combined total, with the requisite inclusions and exclusions. Language is made the medium for indicating the things that are to be brought together, in the formation of the new compound.

16. With regard to the describing art in general, as applicable to all cases where a complex object or scene has to be represented to the view, the leading maxim is to combine a concrete or a *type* of the whole, with an *enumeration* of the parts. This is in accordance with what has just been laid down, respecting the best method of rising from abstract elements to a concrete embodiment. Some comprehensive designation that may spread out the main features of the object is indispensable to the description; and within

this, the details may be arranged in proper form and order. The following is a very simple instance from Milton, which seems as if it could not have been stated otherwise than he has done; but art shows itself in carrying into complicated cases the method that appears self-evident in easy cases. The words in italics mark the comprehensive designation or type, the rest of the description giving the details :—

> They plucked *the seated hills*, with all their load—
> Rocks, waters, woods—and by the shaggy tops
> Up-lifting, bore them in their hands.*

The power of bodying forth or realizing what is described in language is one of the meanings of Conception, which is given by some writers in the list of intellectual faculties.

* Carlyle's description of the town and neighbourhood of Dunbar, the scene of Cromwell's decisive victory over the Scotch, is rendered vivid and conceivable, in consequence of his always prefacing particulars and details by terms and epithets that are at once comprehensive and picturesque :—

'The *small* town of Dunbar stands *high and windy*, looking down over its herring boats, over its grim old castle, now much honeycombed, on *one of those projecting rock-promontories* with which that shore of the Firth of Forth is niched and Vandyked as far as the eye can reach. A beautiful sea; good land too, now that the plougher understands his trade; *a grim niched barrier of whinstone* sheltering it from the chafings and tumblings of the big blue German Ocean. Seaward, St. Abb's Head, of whinstone, bounds your horizon to the east, not very far off; west, close by, is the deep bay, and fishy little village of Belhaven; the gloomy Bass and other rock-islets, and farther, the hills of Fife, and *foreshadows of the Highlands*, are visible as you look seaward. From the bottom of Belhaven Bay to that of the next sea-bight St. Abb's-ward, the town and its environs form a *peninsula*. Along the base of which peninsula, "not much above a mile and a half from sea to sea," Oliver Cromwell's army, on Monday, 2d of September, 1650, stands ranked, with its tents and town behind it, in very forlorn circumstances.

'Landward, as you look from the town of Dunbar, there rises, some short mile off, *a dusky continent of barren heath hills;* the Lammermoor, where only mountain sheep can be at home. The crossing of which by any of its boggy passes and brawling stream-courses, no army, hardly a solitary Scotch packman, could attempt in such weather. To the edge of these Lammermoor heights David Leslie has betaken himself; lies now along the utmost spur of them, a long hill of considerable height. There lies he since Sunday night, on the top and slope of this Doon Hill, with the impassable heath continents behind him; embraces, as with outspread tiger-claws, the base line of Oliver's Dunbar *peninsula*.'

The same power is also expressed by Imagination, although not amounting to what is implied under this faculty. There are three different intellectual operations, all based upon our sense-perceptions—Memory, or the literal reproduction of something experienced; Conception, or the picturing of what is described, by means of a constructive operation; and Imagination proper, which implies the construction of something neither experienced nor presented to us in description by others. Although these operations progressively increase in difficulty, yet there is a common aptitude at the bottom. He that has the most vivid pictorial Memory, will have a corresponding facility in Conception, and in the still higher power of Imagination.

CONSTRUCTIVENESS IN SCIENCE.

17. The Abstractions, Inductions, Deductions, and Experimental processes of science, which we have already seen to be mainly dependent upon the workings of the law of Similarity, afford likewise examples of Construction.

The first in order of the Scientific processes is Abstraction, or the generalizing of a single attribute, so as to present it to the mind, apart from the other properties that usually go along with it in Nature. Thus a square in Euclid is an abstraction: in nature, squareness is always accompanied with other properties, making the concrete, or actual, square,—a square pane of glass, a square of houses, &c. We have already seen that the forming of these abstract ideas is a result of the identifying action expressed by the law of Similarity. (See Similarity, § 34.) We have now to point out the cases, where a considerable constructive effort is required in addition to the force of identification. There are abstractions of a peculiar order of subtlety, which cannot be arrived at, or embraced by the mind, except through a constructive operation, adapted to the case by much study of the particular instances. Take, for instance, the abstract idea of a gas. Here the material eludes the senses, and cannot be represented by either an example, or an outline,—like a mountain, or a circle, or a genus of plants. And if the individual gases are so difficult to represent, there must be a similar difficulty in attaining an idea of the property common to them all as a class. A case of this nature must be circumvented. When we have ascertained by experiment the properties of one gas, such as the air, we record them in the best language we can obtain, by comparison with the more palpable phenomena of solids and fluids. We find that the air is inert, and has weight; that it is elastic, like a spring: but that it is extremely light. Trying other gases we find similar properties to hold good. When, however, we experiment on the visible vapour of water, we find an absence of the elastic property belonging to air and invisible steam; in fact, this substance has nothing in common with aeriform bodies, but lightness or tenuity; and, in the exercise of our discretion, we think it right to exclude it from the group, and embrace together only those that have the property of elasticity, or spontaneous expansion, constituting this the defining mark, or the abstract idea of the class.

By a similar process of groping, experiment, and the exercise of judgment, the scientific world has attained to abstract conceptions of the subtle properties expressed by Heat, Electricity, Chemical affinity, Cell-reproduction, &c. The definitions of these attributes are constructions laboriously worked out. Nevertheless, the means of effecting them, so far as intellect is concerned, is still by the ordinary forces of association, which bring up to the view various facts, expressions, and comparisons, in order to make tentative combinations; and these are gradually improved upon, as their unsuitability to the particular phenomena is discovered on examination. An intellect well versed in the kind of conceptions necessary, and acting vigorously in the reviving of these by association, is naturally qualified for the work. Next to this, is the second leading condition of constructiveness in general—a clear perception of the subject to be seized, or of the particulars to be suited.

Possessing thus the material of the construction and a clear sense of the fitness or unfitness of each new tentative, the operator proceeds to ply the third requisite of constructiveness—trial and error—or as Newton termed it, 'patient thought,' to attain the desired result. This power of patient thought may repose upon a strong bent of mind towards the subject in hand, a passion or fascination for the peculiar class of ideas concerned, such that these ideas can be detained and dwelt upon without costing effort. The mathematical mind, in addition to its intellectual aptitude for retaining and recovering mathematical forms, should have this congenial liking for these forms, in order to prepare it for original discovery. The number of trials necessary to arrive at a new construction, is commonly so great, that, without something of an affection, or fascination, for the subject, one grows weary of the task. The patient thought of the naturalist, desirous of rising to new classifications, grows out of his liking for the subject, which makes it to him a sweet morsel rolled under the tongue, and gives an enjoyment even to fruitless endeavours. This is the *emotional* condition of originality of mind in any department. When Napoleon described himself as '*un homme politique*,' we are to interpret the expression as implying a man of the political fibre or grain, a character whose charm of existence was the handling of political combinations, so that his mind could dwell with ease in this region of ideas.

18. What has been said above, with reference to the Abstractive process of science, applies also to Induction,—the generalizing of *propositions*, or truths. This may be a simple effort of the reproductive force of similarity; or there may be wanted a constructive process in addition. In generalizing the law of the bending of light in passing from one medium to another, Snell constructed a proposition by bringing in a foreign element, namely, the geometrical sines of the angles: he found that the degree of bending was as the sine of the inclination of the ray. This is a good example of the devices required to attain to a general law. A mind well

versed in such foreign elements, apt to revive them, and disposed to dwell upon them, will be the most likely to succeed in the happy fetches and combinations that clench great principles of science.

19. In the processes of Deduction, by which general laws and principles are applied to the clearing up of particular cases, and to the solving of problems, the same constructive process has often to be introduced. The mind being prepared beforehand with the principles most likely for the purpose, and having a vigorous power of similarity in that region, incubates in patient thought over the problem, trying and rejecting, until at last the proper elements come together in the view, and fall into their places in a fitting combination.

The vast structure of the mathematical sciences is a striking example of constructiveness, as distinguished from the discoveries of mere identification through the law of similarity. In Geometry, in Algebra, in the higher Calculus, and in the endless devices of refined analysis, we see an apparatus perfectly unprecedented, the result of a long series of artificial constructions for the working out of particular ends. It would not be difficult to trace out the course of this creative energy; the mental forces involved in it being no other than those that we have dwelt upon.

20. In the devices of Experimental science, there comes into play a constructiveness akin to invention in the arts and manufactures. The air-pump, for example, is an illustrious piece of constructive ingenuity. The machine already in use for pumping water had to be changed and adapted to suit the case of air; and it was necessary that some one well versed in mechanical expedients, and able to recall them on slight hints of contiguity, or similarity, should go through the tedious course of trials that such a case required.

Putting together the applications of the Retentive power of the mind in Science (Contiguity, § 70), the explanation of the operations of Abstraction, Induction, and Deduction (Similarity, § 34-6), and what has now been said as to the nature of the Constructive operation, we have an account, as complete as I am able to give, of the composition of the Reasoning faculty, viewed in its most comprehensive application.

PRACTICAL CONSTRUCTIONS.

21. The region of inventions for the practical ends of life might be traversed for illustrations of constructive genius. So, the department of administrative capacity in every class of affairs, and every kind of business, might be explored with the same view.

Not one of the leading mental peculiarities above laid down as applicable to scientific constructiveness, can be dispensed with in the constructions of practice :—the intellectual store of ideas applicable to the special department; the powerful action of the associating forces; a very clear perception of the end, in other words, sound judgment; and, lastly, that patient thought, which is properly an entranced devotion of the energies to the subject in hand, rendering application to it spontaneous and easy.

With reference to originality in all departments, whether science, practice, or fine art, there is a point of character that deserves notice, as being more obviously of value in practical inventions and in the conduct of business and affairs—I mean an Active turn, or a profuseness of energy, put forth in trials of all kinds on the chance of making lucky hits. In science, meditation and speculation can do much, but in practice, a disposition to try experiments is of the greatest service. Nothing less than a fanaticism of experimentation could have given birth to some of our grandest practical combinations. The great discovery of Daguerre, for example, could not have been regularly worked out by any systematic and orderly research; there was no way but to stumble on it, so unlikely and remote were the actions brought together in one consecutive process. The discovery is unaccountable, until we learn that the author had been devoting himself to experiments for improving the diorama, and thereby got deeply involved in trials and operations far removed from the beaten paths of inquiry. The energy that prompts to endless attempts was found in a surprising degree in Kepler. A similar untiring energy—the union of an active temperament with intense fascination for his subject—appears in the character of Sir William Herschel. When these two attributes are conjoined; when profuse active vigour operates on a field that has an unceasing charm for the mind, we then see human nature surpassing itself.

The invention of Daguerre* illustrates—by a modern instance—the probable method whereby some of the most ancient inventions were arrived at. The inventions of the scarlet dye, of glass, of soap, of gunpowder, could have come only by accident; but the accident, in most of them, would probably fall into the hands of men engaged in numerous trials upon the materials involved. Intense application,—'days of watching, nights of waking,'—went with ancient discoveries as well as with modern. In the historical instances, we know as much. The mental absorption of Archimedes is a proverb.

A remark may be made here, applicable alike to Science and to Practice. Originality in either takes two forms—Observation or Experiment on the one hand, and the identifying processes of Abstraction, Induction, and Deduction on the other. In the first, the bodily activities and the senses are requisite; the last are the purely intellectual forces. It is not by high intellectual force that a man discovers new countries, new plants, new properties of objects; it is by putting forth an unusual force of activity, adventure, inquisitorial and persevering search. All this is necessary in order to obtain the observations and facts in the first instance; when these are collected in sufficient number, a different aptitude is brought

* The wonderful part of this discovery consists in the succession of processes that had to concur in one operation, before any effect could arise. Having taken a silver plate, iodine is first used to coat the surface; the surface is then exposed to the light, but the effect produced is not apparent till the plate has been immersed in the vapour of mercury. To fall upon such a combination, without any clue derived from previous knowledge, an innumerable series of fruitless trials must have been gone through.

to bear. By identifying and assimilating the scattered materials, general properties and general truths are obtained, and these may be pushed deductively into new applications; in all which, a powerful reach of Similarity is the main requisite; and this may be owned by men totally destitute of the active qualities necessary for observation and experiment.

22. The present topic furnishes a good opportunity for singling out, for more special notice, the quality of mind known by the name of Judgment. I have already included a clear perception of the end to be served, as essential to a high order of constructive ingenuity, simply because without this, though there may be a great profusion of devices and suggestions bearing upon the required combination, the fitting result is really not arrived at. Some combination short of the exigencies of the case is acquiesced in.

The various regions of practice differ much in respect of the explicitness of the signs of success. In some things there is no doubt at all; we all know when we have made a good dinner, when our clothing is warm, or when a wound has healed. The miller knows when there is water enough for his mill, and the trader knows when he has found out a good market. The end in those cases is so clear and manifest, that no one is deluded into the notion of having compassed it, if such be not the fact. But in more complex affairs, where perfect success is unattainable, there is room for doubts as to the degree actually arrived at. Thus in public administration we look only for doing good in a considerable majority of instances, and it is often easy to take a minority for a majority. So in acting upon human beings, as in the arts of teaching, advising, directing, persuading, we may suffer ourselves to fall into a very lax judgment of what we have actually achieved, and may thus rest satisfied with easy exertions and flimsily-put-together advices. A sound judgment, meaning a clear and precise perception of what is really effected by the contrivances employed, is to be looked upon as the first requisite of the practical man. He may be meagre in intellectual resources, he may be slow in getting forward and putting together the appropriate devices, but if his perception of the end is unfaltering and strong, he will do no mischief and practise no quackery. He may have to wait long in order to bring together the apposite machinery, but when he has done so to the satisfaction of his own thorough judgment, the success will be above dispute. Judgment is in general more important than fertility; because a man, by consulting others and studying what has been already done, may usually obtain suggestions enough, but if his judgment of the end is loose, the highest exuberance of intellect is only a snare.

The adapting of one's views and plans to the opinions of others is an interesting case of constructiveness, and would illustrate all the difficulties that ever belong to the operation. A more abundant intellectual suggestiveness is requisite, according as the conditions of the combination are multiplied; we must transform our plan into a new one containing the essentials of success, with the addition that it must conform to the plan of some other person. There is in that case a considerable amount of moral effort, as well as of intellectual adaptation; the giving way to other men's views being by no means indifferent to our own feelings.

The subject of Speech in general would present some aspects of the constructive mechanism not hitherto dwelt upon in our exposition. A fluent speaker constructing verbal combinations adapted to all the exigencies of meaning, grammar, taste, and cadence, as fast as the voice can utter them, is an object interesting to study in the present connexion. The Italian Improvisatori furnish a still higher example. The sufficiently *rapid* action of the associating forces is here of prime importance. Real power is not usually identified with a specific pace of mental movement; a slow action may be as effective as a quick; but in this particular instance, the ready revival of all the associations that concur in the common stream is the main element of success.

FINE ART CONSTRUCTIONS.—IMAGINATION.

23. The grand peculiarity of the case now to be considered is the presence of an *emotional* element in the combinations. In the constructions of science and of practice, a certain end is to be served—the attainment of truth, or the working out of a practical result; and the mind has to choose means suitable to those ends, according to the rigorous laws of nature's working. A builder has to erect a structure that will defy wind and frost, and accommodate a certain number of human beings. Nothing must enter into his plan that is not calculated to effect these purposes. The construction is considered a pure effort of intellect, because it is by intellect that we comprehend the laws and properties of stone, wood, and iron, and choose out and combine such materials as will serve for warmth and shelter. We should not properly call this operation 'imaginative,' although there is a constructive process gone through; simply because no feeling or emotion enters in as an element, excepting the one feeling of answering a practical end. Volition there is in abundance, but not emotion as understood in the constructive processes of the imagination.

When, however, any practical construction, such as a building, in addition to the uses of shelter and accommodation, is intended to strike the refined sensibilities that we term the feeling of the beautiful, the grand, the picturesque, a turn must be given to the plan so as to involve this other end. Here we have emotion viewed in a certain narrow sense, as exclusive of direct utility for the wants and necessities of life. We possess feelings of warmth, of repletion, of repose; but these are not consulted in fine art. The securing such pleasures as these, and the warding off the opposite pains, and all pains connected with our physical organs, are among the ends of *practical* art. When these practical ends are secured, there are other feelings and sentiments belonging to human nature that can be touched in a way to increase the sum of human happiness. These are variously called the pleasures of Taste, the æsthetic sensibilities, the emotions of Fine Art; and combinations shaped with the view of gratifying them are called artistic, æsthetic, or *imaginative* compositions. In all such compositions, an element of refined emotion is the regulating power, the all in all of the creative effort.*

24. In adducing examples of combinations controlled by

* The following passage will aid us in working out the distinction between the constructions of imagination and the constructions of science and practice: —

'The trains of one class differ from those of another, the trains of the merchant for example, from those of the lawyer, not in this, that the ideas follow one another by any other law, in the mind of the one, and the mind of the other; they follow by the same laws exactly; and are equally composed of ideas, mixed indeed with sensations, in the minds of both. The difference consists in this, that the ideas which flow in their minds, and compose their trains, are ideas of different things. The ideas of the lawyer are ideas of the legal provisions, forms, and distinctions, and of the actions, bodily and mental, about which he is conversant. The ideas of the merchant are equally ideas of the objects and operations, about which he is concerned, and the ends towards which his actions are directed; but the objects and operations themselves are remarkably different. The trains of poets, also, do not differ from the trains of other men, but perfectly agree with them in this, that they are composed of ideas, and that those ideas succeed one another, according to the same laws, in their, and in other minds. They are ideas, however, of very different things. The ideas of the poet are ideas of all that is most lovely and striking in the visible appearance of nature, and of all that is most interesting in the actions and affections of human beings. It thus, however, appears most manifestly, that the trains of poets differ from those of other men in no other way, than those of other men differ from one another; that they differ from them by this only, that the ideas of which they are composed, are ideas of different things. There is also nothing surprising in this, that, being trains of pleasurable ideas, they should have attracted a peculiar degree of attention; and in an early age, when poetry was the only literature, should have been thought worthy of a more particular naming, than the trains of any other class. These reasons seem to account for a sort of appropriation of the name Imagination to the trains of the poet. An additional reason may be seen in another circumstance, which also affords an interesting illustration of a law of association already propounded; namely, the obscuration of the antecedent part of a train, which leads to a subsequent, more interesting than itself. In the case of the lawyer, the train leads to a decision favourable to the side which he advocates. The train has nothing pleasurable in itself. The pleasure is all derived from the end. The same is the case with the merchant. His trains are directed to a particular end. And it is the end alone which gives a an emotional element, I shall not confine myself to the narrowest class of artistic feelings, the feelings of Taste properly so called; the fact being that, even in the creations of the artist, all the strong emotions may come in to swell the current of interest, excepting only a few of the more exclusively animal feelings. Rage, terror, tenderness, egotism,

value to the train. The end of the metaphysical, and the end of the mathematical inquirer is the discovery of truth; their trains are directed to that object; and are, or are not, a source of pleasure, as that end is, or is not, attained. But the case is perfectly different with the poet. His train is its own end. It is all delightful, or the purpose is frustrate. From the established laws of association, this consequence unavoidably followed; that, in the case of the trains of those other classes, the interest of which was concentrated in the end, attention was withdrawn from the train by being fixed on the end, that, in the case of the poet, on the other hand, the train itself being the only object, and that pleasurable, the attention was wholly fixed upon the train; that hence the train of the poet was provided with a name; that, in the cases of the trains of other men, where the end only was interesting, it was thought enough that the end itself should be named, the train was neglected.

'In conformity with this observation, we find that wherever there is a train which leads to nothing beyond itself, and has any pretension to the character of pleasurable (the various kinds of reverie, for example) it is allowed the name of Imagination. Thus we say that Rousseau indulged his imagination, when, as he himself describes it, lying on his back, in his boat, on the little lake of Vienne, he delivered himself up for hours to trains, of which, he says, the pleasure surpassed every other enjoyment.

'Professor Dugald Stewart has given to the word Imagination a technical meaning, without, as it appears to me, any corresponding advantage. He confines it to the cases in which the mind forms new combinations; or, as he calls them, creations; that is, to cases in which the ideas which compose the train do not come together in the same combinations in which sensations had ever been received. But this is no specific difference. This happens in every train of any considerable length, whether directed to any end, or not so directed. It is implied in every wish of the child to fly, or to jump over the house; in a large proportion of all his playful expressions, as puss in boots, a hog in armour, a monkey preaching, and so on. It is manifested in perfection in every dream. It is well known that, for the discovery of truths in philosophy, there is a demand for new trains of thought, multitudes of which pass in review before the mind, are contemplated, and rejected, before the happy combination is attained, in which the discovery is involved. If imagination consists in bringing trains before the mind involving a number of new combinations, imagination is probably more the occupation of the philosopher than of the poet.'—MILL's *Analysis*, vol. i. p. 181.

are not æsthetic emotions, but still the artist uses them in his compositions. I should also remark that the influence of the emotions, while just and legitimate in the artistic sphere, is usually a source of corruption and bias in the combinations that have truth or practice for their end. This is what is meant by saying that imagination is not to occupy the place of judgment and reason.

The emotion of Terror gives a character to all the ideas or notions formed under the influence of the feeling. A man once thoroughly terrified sees only objects of dread. It is difficult to form any combinations free of this element. Ghosts and hobgoblins fill the imagination of the superstitious, while more substantial forms of evil haunt a mind unaffected by the dread of the supernatural. The terrified imagination is powerful to form creations of terror, such as may prove an interesting excitement to the cool spectator, but which are also likely to vitiate the truth of any narrative of matter of fact given out under the influence of the moment. Hence the accounts that a terror-stricken and routed army relate as to the numbers and power of the enemy on its heels; hence the exaggerations that prevail in the public mind on occasions of popular panic. We see the power of an emotion, not merely to give its own character to the conceptions formed on all subjects, but to induce belief in the full and exact reality of such conceptions.

With reference to examples of constructiveness of the class now cited, I may repeat the remark already made, to the effect that no new principle of association is at work in making an original combination; the only thing requisite being the presence or concurrence of the proper ingredients as furnished by the working of Contiguity and Similarity. When these ingredients appear in the mind together, they fall into their places as a matter of course. In the present instance, and in all imaginative or emotion-ruled combinations, the laws of association can be proved to be sufficient to furnish the constituents of the combination; for we know that each strong feeling or passion has, associated with it in the mind, a large number of kindred objects, in consequence of the previous frequent companionship of such objects with the feeling. The passion of terror is connected with the things that have roused the feeling in the course of each one's experience ; one man has associations between it and a cruel parent or master, another with money losses, a third with attacks of illness, a fourth with defamation, a fifth with religious workings ; and most men are familiar with a plurality of causes of dread. When, therefore, the feeling is once excited, no matter how, these often-experienced adjuncts start up and possess the mind, and mix themselves with the other ideas of the situation, so as to constitute a medley or compound of images, with terror as the predominating tone. Seeing the approach of a hurried messenger with distracted countenance, the trader's mind is already full of disasters at sea or depressions of the market, the parent of a soldier is made to think of the calamities of warfare, the usurper is ready with the anticipation of a popular rising.

An exactly parallel illustration might be given from the passion of Anger. Once roused, this passion resuscitates the objects in harmony with it, and puts together combinations wherein these enter as elements. The fanaticism of rage and hatred ascribes every diabolical impulse to the unfortunate object of the feeling ; all the things that have customarily inspired anger are brought forward by contiguous association, and the instigator of the present outburst is looked on as guilty of innumerable crimes, in addition to the offence of the moment. This is an extreme case, but not unexampled in the history of the world. Party-rage brands opponents with the most unheard-of crimes ; the term, 'calumny,' expresses this surplus of accusation against those that have excited the passion of hate.

25. The purely Egotistic feelings are remarkable for the superstructure of imaginative creations that they can rear. Self-complacency suggests merits and virtues, and constructs an estimate of self most flattering. Vanity sets up pictures of admiring assemblies and devoted worshippers. But most

curious of all are the day-dreams of ambition in a sanguine temperament; these will embrace a whole history of the future, the baseless fabric of a vision of wonders and triumphs, which is not only constructed without labour, but whose construction no labour can arrest. In former sections, we have adverted to the difficult efforts of constructiveness; we have seen how hard it often is to comply with the numerous conditions that a construction must fulfil, or to give a place to all the ingredients that should be represented in it; so much so, that the attempt may have to be repeated time after time, before everything falls into the proper places. A scientific man framing a definition for a very comprehensive class of objects, a mechanician constructing a new machine, a politician devising a state expedient, a general circumventing a hostile army,—will be each engaged in deliberations, for days or months, ere the proper combinations occur to the mind. One suggestion includes something to be avoided, another omits something that ought to be present, and long delays and repeated substitutions and trials precede the successful termination of the struggle. But in the case now supposed, all is different: stupendous constructiveness, unbounded originality, flow out at once as fast as thought can evolve itself. Wherein lies the remarkable difference in these two forms of constructiveness? The immortal crockery merchant constructed, in a few minutes, a lengthened fiction, totally distinct from anything he had ever seen realized in actual life. Why has emotion such power? The answer is simple. A predominating emotion, such as Ambition, is every day at work associating itself with objects and incidents suited to gratify it. The feeling is called into play by every spectacle of power and grandeur that meets the eye, or is presented in story. The associating link is soon forged in the hot fire of passion; and, after months and years of indulgence of a favourite emotion, a rich growth of the corresponding objects and ideas is formed and ready to flow out, at any moment when the feeling is roused. Imagination in those circumstances becomes a power needing restraint, rather than an effort of laboured constructiveness. The foregone associations with the feeling are so copious, that they present themselves freely for any purpose. Construction is easy where materials are abundant and the conditions few : the owner of the crockery-basket had amassed pictures of happiness and grandeur, which required only to be cast into a consecutive order to make his epic, and an extempore effort was enough for this. The only condition was to satisfy one feeling ; all restrictions were thrown aside, and he had plenty of images to suit the single emotion that lorded it over his dream. Very different would have been the pace of his execution, if he had insisted that this foreshadowing of his career should be in accordance with the stern experience of human life ; if his picture should have been regulated by natural calculation, founded on known realities. This would have dried up his facility in a moment ; he would then have been in the contrasted position, above described, of the man of science, or the man of business ; a feeling might have still been the end, but purely intellectual estimates of the facts and laws of the world would have entered into his construction of the means. The reconciliation of his desires with the resources of his position would have been as arduous as a string of airy successes was easy. The process might have had ever so much of the constructive intellect, and the combination might have been ever so original ; but the term 'imagination' would no longer be used to describe it.

26. The Fine Art emotions, properly so called, the emotions of harmony, beauty, sublimity, picturesqueness, pathos, humour, become associated, in the artistic mind, with the objects that radiate the influence on the beholder. From the materials thus stored up and reproduced by association the artist makes his constructions. I have in a former chapter (Contiguity, § 75) adverted to the mental equipment suitable to the artist in any department ; and it is scarcely necessary to repeat, what I have endeavoured to illustrate, throughout the present chapter, that, when all the elements are present that fit into a particular construction,

they will take their places as a matter of course. The labour consists in getting up the constituent parts from the repositories of the mind, and in choosing and rejecting until the end in view is completely answered. Because the imaginations of a dreamer are easy and fluent, it does not follow that the imaginations of a musician, an architect, or a poet, shall be equally easy, although in principle the same being governed by an emotion powerfully developed and richly associated with material. The artist has more stringent conditions to fulfil than the dreamer. He has to satisfy the reigning feeling of his piece,—the melody, harmony, pathos, humour, of the composition; he has also to make this effect apparent to the minds of others; he has moreover to exclude many effects discordant to the taste of his audience; and, if his work be the decoration of some object of common usefulness, he has to save the utilities while in search of the amenities. Every new restriction adds to the difficulty of a combining effort; and an artist may be so trammelled with conditions, that the exercise of imagination shall be rendered as laborious as any construction of the reason. To call up combinations that produce powerful and rich effects upon the minds of men is not easy in any art; but the gathered abundance of the artistic intellect is the secret of the power. The more rich the granary of material, the more is the artist prepared to submit to the numerous conditions involved in a really great performance.

27. I do not purpose at present to enter upon a minute illustration of the mental processes of art-construction. Not only would a large space be requisite for spreading out the examples in detail, but there would soon come to be involved a strenuous polemical discussion, in consequence of the prevalence of theories of art that seem to me erroneous. Conceiving, as I do, that the first object of an artist is to gratify the feelings of taste, or the proper æsthetic emotions, I cannot assent to the current maxim that nature is his standard, or truth his chief end. On the contrary, I believe that these are precisely the conditions of the scientific man;

he it is that should never deviate from nature, and that should care for truth before all other things. The artist's standard is *feeling*, his end is refined pleasure; he goes to nature, and selects what chimes in with his feelings of artistic effect, and passes by the rest. He is not even bound to adhere to nature in her very choicest displays; his own taste being the touchstone, he alters the originals at his will. The scientific man, on the other hand, must embrace every fact with open arms; the most nauseous fungus, the most loathsome reptile, the most pestilential vapour, must be scanned and set forth in all its details.

The amount of regard that the artist shows to truth, so far as I am able to judge, is nearly as follows. In the purely effusive arts, such as music or the dance, truth and nature are totally irrelevant; the artist's feeling, and the gratification of the senses of mankind generally, are the sole criterion of the effect. So, in the fancies of decorative art, nature has very little place; suggestions are occasionally derived from natural objects, but no one is bound to adopt more of these than good taste may allow. Nobody talks of the design of a calico as being true to nature; it is enough if it please the eye. 'Art is art because it is not nature.' The artist provides dainties not to be found in nature. There are, however, certain departments of art that differ considerably from music and fanciful decoration, in this respect, namely, that the basis of the composition is generally something actual, or something derived from the existing realities of nature or life. Such are painting, poetry, and romance. In these, nature gives the subject, and the artistic genius the adornment. Now, although, in their case also, the gratification of the senses and the æsthetic sensibilities is still the aim of the artist, he has to show a certain decent respect to our experience of reality in the management of his subject; this not being purely imaginary, like the figures of a calico, but chosen from the world of reality. Hence, when a painter makes choice of the human figure, in order to display his harmonies of colour, and beauties of form, and picturesqueness of grouping,—he ought not to shock our feeling of truth and consistency, by a wide departure from the usual proportions of humanity. We do not look for anatomical exactness; we know that the studies of an artist do not imply the knowledge of a professor of anatomy; but we expect that the main features of reality shall be adhered to. In like manner, a poet is not great because he exhibits human nature with literal fidelity; to do that would make the reputation of a historian or a mental philosopher. The poet is great by his metres, his cadences, his images, his picturesque groupings, his graceful narrative, his exaltation of reality into the region of ideality; and if, in doing all this, he avoid serious blunders or gross exaggerations, he passes without rebuke, and earns the unqualified honours of his genius.

28. The attempt to reconcile the artistic with the true,—art with nature,—has given birth to a middle school, in whose productions a restraint is put upon the flights of pure imagination, and which claims the merit of informing the mind as to the realities of the world, while gratifying the various æsthetic emotions. Instead of the tales of Fairy-Land, the Arabian Nights, the Romances of Chivalry, we have the modern novelist, with his pictures of living men and manners. In painting, we have natural scenery, buildings, men, and animals, represented with scrupulous exactness. The sculptor and the painter exercise the vocation of producing portraits that shall hand down to future ages the precise lineaments of the men and women of their generation. Hence, the study of nature has become a main element in artistic education; and the artist often speaks as if the exhibition of truth were his prime endeavour, and his highest honour. It is probably this attempt, to subject imagination to the conditions of truth and reality, that has caused the singular transference above mentioned, whereby the definition of science has been made the definition of art.

Now, I have every desire to do justice to the merits of the truth-seeking artist. Indeed, the importance of the reconciliation that he aims at is undeniable. It is no slight matter to take out the sting from pleasure, and to avoid corrupting our notions of reality, while gratifying our artistic sensibilities. A sober modern romancist does not outrage the probabilities of human life, nor excite delusive and extravagant hopes, in the manner of the middle-age romances. The change is in a good direction.

Nevertheless, there is, and always will be, a distinction between the degree of truth attainable by an artist, and the degree of truth attained by a man of science or a man of business. The poet, let him desire it never so much, cannot study realities with an undivided attention. His readers do not desire truth simply for its own sake ; neither will they accept it in the severe forms of an accurate terminology. The scientific man has not wantonly created the diagrams of Euclid, the symbols of Algebra, or the jargon of technical Anatomy ; he was forced into these repulsive elements, because, in no other way, could he seize the realities of nature with precision. It cannot be supposed that the utmost plenitude of poetic genius shall ever be able to represent the world faithfully, by discarding all these devices in favour of flowery ornament and melodious metre. We ought not to look to an artist to guide us to truth ; it is enough for him that he do not mis-guide us.

APPENDIX.

PSYCHOLOGY OF ARISTOTLE.

To understand Aristotle's Psychology, we must look at it in comparison with the views of other ancient Greek philosophers on the same subject, as far as our knowledge will permit. Of these ancient philosophers, none have been preserved to us except Plato, and to a certain extent Epikurus, reckoning the poem of Lucretius as a complement to the epistolary remnants of Epikurus himself. The predecessors of Aristotle (apart from Plato) are known only through small fragments from themselves, and imperfect notices by others; among which notices the best are from Aristotle himself.

In the Timæus of Plato, we find Psychology, in a very large and comprehensive sense, identified with Kosmology. The Kosmos, a scheme of rotatory spheres, has both a soul and a body:—of the two, the soul is the prior, grander, and predominant, though both of them are constructed or put together by the Divine Architect or Demiurgus. The Kosmical soul, rooted at the centre, and stretched from thence through and around the whole, is indued with self-movement, and with the power of initiating movement in the Kosmical body: moreover, being cognitive as well as motive, it includes in itself three ingredients mixed together:—1. The Same—the indivisible and unchangeable essence of Ideas; 2. The Diverse—the Plural—the divisible bodies or elements; 3. A third compound, formed of both these ingredients melted into one. As the Kosmical Soul is intended to know all the three—Idem, Diversum, and Idem with Diversum in one; so it must comprise in its own nature all the three ingredients, according to the received Axiom—

Like knows like—Like is known by like.* The ingredients are blended together according to a scale of harmonic proportion. The element Idem is placed in an even and undivided rotation of the outer or sidereal sphere of the Kosmos; the element Diversum is distributed among the rotations, all oblique, of the seven interior planetary spheres, that is, the five planets, with the Sun and Moon. Impressions of identity and diversity, derived either from the ideal and indivisible, or from the sensible and divisible, are thus circulated by the kosmical soul throughout its own entire range, yet without either voice or sound. Reason and Science are propagated by the Circle of Idem: Sense and Opinion, by those of Diversum. When these last-mentioned Circles are in right movement, the opinions circulated are true and trustworthy.

It is thus that Plato begins his Psychology with Kosmology; the Kosmos is in his view a Divine Immortal being or animal, composed of a spherical rotatory body and a rational soul, cognitive as well as motive. Among the tenants of this Kosmos are included, not only gods, who dwell in the peripheral or celestial regions, but also men, birds, quadrupeds, and fishes. These four inhabit the more central or lower regions of air, earth, and water. In describing men and the inferior animals, Plato takes his departure from the divine Kosmos, and proceeds downwards by successive stages of increasing degeneracy and corruption. The cranium of man was constructed as a little Kosmos, including in itself an immortal rational soul, composed of the same materials, though diluted and adulterated, as the kosmical soul; and moving with the like rotations, though disturbed and irregular, suited to a rational soul. This cranium, for wise purposes which Plato indicates, was elevated by the gods upon a tall body, with attached limbs for motion in different directions—forward, backward, upward, downward, to the right and left.† Within this body were included two inferior and mortal souls; one in the thoracic region near the heart, the other lower down below the diaphragm, in the abdominal region; but both of them fastened or rooted in the spinal marrow or cord, which formed a continuous line with the brain above. These two souls were

* See this doctrine of the Timæus more fully expounded in Grote's 'Plato and the Other Companions of Sokrates,' Vol. III., c. 36, p. 250-256 seq.

† Plato, Timæus, p. 44 E.; Grote's Plato, Vol. III., c. 36, p. 264.

both emotional; the higher or *thoracic* soul being the seat of courage, energy, anger, &c., while to the lower or *abdominal* soul belonged appetite, desires, love of gain, &c. Both of them were intended as companions and adjuncts, yet in the relation of dependence and obedience, to the *rational* soul in the *cranium* above; which, though unavoidably debased and perturbed by such unworthy companionship, was protected partially against the contagion by the difference of location—the neck being built up as an isthmus of separation between the two. The thoracic soul, the seat of courage, was placed nearer to the head, in order that it might be the medium for transmitting influence from the cranial soul above, to the abdominal soul below; which last was at once the least worthy and the most difficult to control. The heart, being the initial point of the veins, received the orders and inspirations of the cranial soul, transmitting them onward through its many blood-channels to all the sensitive parts of the body; which were thus rendered obedient, as far as possible, to the authority of man's rational nature.* The unity or communication of the three souls was kept up through the continuity of the cerebro-spinal column.

But though, by these arrangements, the higher soul in the cranium was enabled to control to a certain extent its inferior allies, it was itself much disturbed and contaminated by their reaction. The violence of passion and appetite, the constant processes of nutrition and sensation pervading the whole body, the multifarious movements of the limbs and trunk, in all varieties of direction,—these causes all contributed to agitate and to confuse the rotations of the cranial soul, perverting the arithmetical proportions and harmony belonging to them. The Circles of Same and Diverse were made to convey false information; and the soul, for some time after its first junction with the body, became destitute of intelligence.† In mature life, indeed, the violence of the disturbing causes abates, and the man may become more and more intelligent, especially if placed under appropriate training and education. But in many causes, no such improvement took place; and the rational soul of man was irrecoverably spoiled; so that new and worse breeds were formed, by successive steps of degeneracy. The first stage, and the

* Plato, Timæus, p. 70; Grote's Plato, Vol. III., p. 271-272.

† Plato, Timæus, p. 43-44; Grote's Plato, Vol. III., p. 262-264.

least amount of degeneracy, was exhibited in the formation of woman—the original type of man not having included diversity of sex. By farther steps of degradation, in different ways, the inferior animals were formed—birds, quadrupeds, and fishes.* In each of these, the rational soul became weaker and worse; its circular rotations ceased with the disappearance of the spherical cranium, and animal appetites with sensational agitations were left without control. As man, with his two emotional souls and body joined on to the rational soul and cranium, was a debased copy of the perfect rational soul and spherical body of the divine Kosmos, so the other inhabitants of the Kosmos proceeded from still farther debasement and disrationalization of the original type of man.

Such is the view of Psychology given by Plato in the Timæus; beginning with the divine Kosmos, and passing downwards from thence to the triple soul of man, as well as to the various still lower successors of degenerated man. It is to be remarked that Plato, though he puts soul as prior to body in dignity and power, and as having for its functions to control and move body, yet always conceives soul as attached to body, and never as altogether detached, not even in the divine Kosmos. The soul, in Plato's view, is self-moving and self-moved: it is both Primum Mobile in itself, and Primum Movens as to the body; it has itself the corporeal properties of being extended and moved, and it has body implicated with it besides.

The theory above described, in so far as it attributes to the soul—rational constituent elements (Idem, Diversum), continuous magnitude, and circular rotations, was peculiar to Plato, and is criticised by Aristotle as the peculiarity of his master.† But several other philosophers agreed with Plato in considering self-motion, together with motive causality and faculties perceptive and cognitive, to be essential characteristics of soul. Alkmæon declared the soul to be in perpetual motion, like all the celestial bodies; hence it was also immortal, as they were.‡ Herakleitus described it as the subtlest of elements, and as perpetually fluent; hence it was enabled to know other things, all of which were in flux and change. Diogenes of Apollonia affirmed that

* Plato, Timæus, p. 91; Grote's Plato, p. 281-282.

† Aristot. De Animâ, I. 3, p. 407, a. 2.

‡ Aristot. De Animâ, I. 2, 405, a. 32.

the element constituent of soul was *air*, at once mobile, all-penetrating, and intelligent. Demokritus declared that among the infinite diversity of atoms, those of spherical figure were the constituents both of the element *fire* and of the soul; the spherical atoms were by reason of their figure the most apt and rapid in moving; it was their nature never to be at rest; and they imparted motion to everything else.* Anaxagoras affirmed Soul to be radically and essentially distinct from every thing else; but to be the great primary source of motion, and to be endued with cognitive power, though at the same time not suffering impressions from without.† Empedokles considered Soul to be a compound of the four elements—*fire*, *air*, *water*, *earth*; with Love and Hatred as principles of motion, the former producing aggregation of elements, the latter, disgregation; by means of each element, the soul became cognizant of the like element in the Kosmos. Some Pythagoreans looked upon the soul as an aggregate of particles of extreme subtlety, which pervaded the air and were in perpetual agitation. Other Pythagoreans, however, declared it to be an harmonious or proportional mixture of contrary elements and qualities; hence its universality of cognition, extending to all.‡

A peculiar theory was delivered by Xenokrates (who, having been fellow-pupil with Aristotle, under Plato, afterwards conducted the Platonic school, during all the time that Aristotle taught at the Lyceum), which Aristotle declares to involve greater difficulty than any of the others. Xenokrates described the soul as "a number—(a Monad or Indivisible Unit)—moving itself." § He retained the self-moving property which Plato had declared to be characteristic of the soul, while he departed from Plato's doctrine of a soul with continuous extension. He thus fell back upon the Pythagorean idea of Number as the fundamental essence. Aristotle impugns, as alike untenable, both the two properties here alleged—number and self-motion. If the Monad both moves and is moved (he argues), it cannot be indivisible; if it be moved, it must have position, or must be a point; but the motion of a point is a line, without any of that variety

* Aristot. De Animâ, I. p. 404, a. 8, 405, a. 22, 406, b. 17.

† Aristot. De Animâ, I. p. 405, a. 13, b. 22.

‡ Aristot. De Animâ, I. p. 404, a. 17, 407, b. 28.

§ Aristot. De Animâ, I. 4, 408, b. 32, 409, b. 12.

that constitutes life. How can the soul be a Monad? or if it be, what difference can exist between one soul and another, since Monads cannot differ from each other except in position? How comes it that some bodies have souls and others not? and how, upon this theory, can we explain the fact that many animated bodies, both plants and animals, will remain alive after being divided—the monadic soul thus exhibiting itself as many and diverse? Besides, the Monad set up by Xenokrates is hardly distinguishable from the highly attenuated body or spherical atom recognized by Demokritus as the origin or beginning of bodily motion.

These and other arguments are employed by Aristotle to refute the theory of Xenokrates. In fact, he rejects all the theories then current. After having dismissed the self-motor doctrine, he proceeds to impugn the views of those who declared the soul to be a compound of all the four elements, in order that they might account for its percipient and cognitive faculties upon the maxim then very generally admitted*—That like is perceived and known by like. This theory, the principal champion of which was Empedokles, appears to Aristotle inadmissible. You say (he remarks) that like knows like; how does this consist with your other doctrine, that like cannot act upon, or suffer from, like, especially as you consider that both in perception and in cognition the percipient and cognizant suffers or is acted upon?† Various parts of the cognizant Subject, such as bone, hair, ligaments, &c., are destitute of perception and cognition; how then can we know anything about bone, hair, and ligaments, since we cannot know them by like?‡ Suppose the Soul to be compounded of all the four elements; this may explain how it comes to know the four elements, themselves, but not how it comes to know all the combinations of the four; now innumerable combinations of the four are comprised among the Cognita. We must assume that the Soul contains in itself not merely the four elements, but also the laws or definite proportions wherein they can combine; and this is affirmed by no one.§ Moreover, Ens is an equivocal, or at least a multivocal, term; there are Entia

* Aristot. De Animâ, I. 5, 409, a. 29.
† Aristot. De Animâ, I. 5, 410, a. 25.
‡ Aristot. De Animâ, I. 5, 410, b. 31.
§ Aristot. De Animâ, I. 5, 409, b. 28, 410, a. 12.

belonging to each of the ten Categories. Now, the Soul cannot include in itself all the ten, for the different categories have no elements in common; in whichever category you rank the soul, it will know (by virtue of likeness) the Cognita belonging to that category, but it will not know the Cognita belonging to the other nine.* Besides, even if we grant that the Soul includes all the four elements, where is the cementing principle that combines all the four into one? The elements are merely matter; and what holds them together must be the really potent principle of soul; but of this no explanation is given.†

Some philosophers have assumed (continues Aristotle) that Soul pervades the whole Kosmos and its elements; and that it is inhaled by animals in respiration along with the air.‡ They forget that all plants, and even some animals, live without respiring at all; moreover, upon this theory, air and fire also, as possessing Soul, and what is said to be a better Soul, ought (if the phrase were permitted) to be regarded as animals. The Soul of air or fire must be homogeneous in its parts; the Souls of animals are not homogeneous, but involve several distinct parts or functions.§ The Soul perceives, cogitates, opines, feels, desires, repudiates; farther, it moves the body locally, and brings about the growth and decay of the body. Here we have a new mystery‖—Is the whole Soul engaged in the performance of each of these functions, or has it a separate part exclusively consecrated to each? If so, how many are the parts? Some philosophers (Plato among them) declare the Soul to be divided, and that one part cogitates and cognizes, while another part desires. But upon that supposition, what is it that holds these different parts together? Certainly not the body (this is Plato's theory); on the contrary, it is the Soul that holds together the body; for as soon as the Soul is gone, the body rots and disappears.¶ If there be any thing that keeps together the divers parts of the Soul as one, that Something must be the true

* Aristot. De Animâ, I. 5, 410, a. 20.

† Aristot. De Animâ, I. 5, 410, b. 12.

‡ Aristot. De Animâ, I. 2, 404, a. 10. τοῦ ζῆν ὅρον εἶναι τὴν ἀναπνοήν, &c. Compare the doctrine of Demokritus.

§ Aristot. De Animâ, I. 5, 411, a. 1-8-16.

‖ Aristot. De Animâ, I. 5, 411, a. 30.

¶ Aristot. De Animâ, I. 5, 411, b. 8.

and fundamental Soul; and we ought not to speak of the Soul as having parts, but as essentially One and Indivisible, with several distinct faculties. Again, if we are to admit *parts* of the Soul, does each part hold together a special part of the body, as the entire Soul holds together the entire body? This seems impossible; for what part of the body can the Nous or Intellect (*e.g.*) be imagined to hold together? And besides, several kinds of plants and of animals may be divided, yet so that each of the separate parts shall still continue to live; hence it is plain that the Soul in each separate part is complete and homogeneous.*

Aristotle thus rejects all the theories proposed by antecedent philosophers, but more especially the two following—That the Soul derives its cognitive powers from the fact of being compounded of the four elements; That the Soul is self-moved. He pronounces it incorrect to say that the Soul is moved at all.† He farther observes that none of the philosophers have kept in view either the full meaning or all the varieties of Soul; and that none of these defective theories suffices for the purpose that every good and sufficient theory ought to serve, viz., not merely to define the essence of the Soul, but also to define it in such a manner that the concomitant functions and affections of the Soul shall all be deducible from it.‡ Lastly, he points out that most of his predecessors had considered that the prominent characteristics of Soul were—To be motive—To be percipient: § while, in his opinion, neither of these two characteristics was universal or fundamental.

Aristotle requires that a good theory of the Soul shall explain alike the lowest vegetable soul, and the highest functions of the human or divine soul. And in commenting on those theorists who declared that the essence of soul consisted in movement, he remarks that their theory fails altogether in regard to the Nous (or cogitative and intellective faculty of the human soul); the operation of which bears far greater analogy to rest or suspension of movement, than to movement itself. ||

* Aristot. De Animâ, I. 5, 411, b. 15-25.

† Aristot. De Animâ, I. 5, 411, a. 25.

‡ Aristot. De Animâ, I. 1, 402, b. 18, seq.; I. 4, 408, a. 4; I. 5, 509, b. 15.

§ Aristot. De Animâ, I. 2. 403, b. 30.

|| Aristot. De Animâ, I. 3, 407, a. 32. ἔτι δ' ἡ νόησις ἔοικεν ἠρεμήσει τινὶ ἢ ἐπιστάσει μᾶλλον ἢ κινήσει.

We shall now proceed to state how Aristotle steers clear (or at least believes himself to steer clear) of the defects that he has pointed out in the psychological theories of his predecessors. Instead of going back (like Empedokles, Plato, and others) to a time when the Kosmos did not yet exist, and giving us an hypothesis to explain how its parts came together or were put together—he takes the facts and objects of the Kosmos as they stand, and distributes them according to distinctive marks alike obvious, fundamental, and pervading; after which he seeks a mode of explanation in the principles of his own Philosophia Prima or Ontology. Whoever had studied the Organon and the Physica of Aristotle (apparently intended to be read prior to the treatise De Animâ) would be familiar with his distribution of Entia into ten Categories, of which, Essence or Substance was the first and the fundamental. Of these Essences or Substances, the most complete and recognized were physical or natural bodies; and among such bodies, one of the most striking distinctions, was between those that had life and those that had it not. By *life*, Aristotle means keeping up the processes of nutrition, growth, and decay.*

"To live" (Aristotle observes) is a term used in several different meanings; whatever possesses any one of the following four properties is said to live.† 1. Intellect. 2. Sensible perception. 3. Local movement and rest. 4. Internal movement of nutrition, growth, and decay. But of these four, the last is the only one common to all living bodies without exception; it is the foundation presupposed by the other three. It is the only one possessed by plants,‡ and common to all plants as well as to all animals; to all animated bodies.

What is the animating principle belonging to each of these bodies, and what is the most general definition of it? Such is

* Aristot. De Animâ, II. 1, 412, a. 15, 412, b. 20. *οὐσίαι δὲ μάλιστ' εἶναι δοκοῦσι τὰ σώματα, καὶ τούτων τὰ φυσικά· τῶν δὲ φυσικῶν τὰ μὲν ἔχει ζωὴν, τὰ δ' οὐκ ἔχει· ζωὴν δὲ λέγω, τὴν δι' αὐτῶν τροφὴν καὶ αὔξησιν καὶ φθίσιν.*

Aristot. De Animâ, II. 1, 413, a. 21. *πλεοναχῶς δὲ τοῦ ζῇν λεγομένου*, &c.

† Aristot. De Animâ, II. 2, 413, a. 22. *πλεοναχῶς δὲ τοῦ ζῇν λεγομένου, κἂν ἕν τι τούτων ἐνυπάρχῃ μόνον, ζῇν αὐτό φαμεν*, &c.

‡ Aristot. De Animâ, I. 411, b. 29, ad fin.

the problem that Aristotle states to himself about the soul.* He explains it by a metaphysical distinction first introduced (apparently) by himself into Philosophia Prima. He considers substance or essence as an ideal compound; not simply as clothed with all the accidents described in the nine last categories, but also as being analyzable in itself, even apart from these accidents, into two abstract, logical, or notional elements or *principia*—Form and Matter. This distinction is borrowed from the most familiar facts of the sensible world—the shape of solid objects. When we see or feel a cube of wax, we distinguish the cubic shape from the waxen material;† we may find the like shape in many other materials—wood, stone, &c.; we may find the like material in many different shapes, sphere, pyramid, &c.; but the matter has always some shape, and the shape has always some matter. We can name and reason about the matter, without attending to the shape, or distinguishing whether it be cube or sphere; we can name and reason about the shape, without attending to the material shaped, or to any of its various peculiarities. But this, though highly useful, is a mere abstraction or notional distinction. There can be no real separation between the two; no shape without some solid material; no solid material without some shape. The two are correlates; each of them implying the other, and neither of them admitting of being realized or actualized without the other.

This distinction of Form and Matter is one of the capital features of Aristotle's Philosophia Prima. He expands it and diversifies it in a thousand ways, often with subtleties very difficult to follow; but the fundamental import of it is seldom lost; two correlates inseparably implicated in fact and reality, in every concrete individual that has received a substantive name,—yet logically separable, and capable of being named and considered apart from each other. The Aristotelian analysis thus brings out, in regard to each individual substance (or Hoc Aliquid, to use his phrase), a triple point of view. 1. The Form. 2. The Matter. 3. The compound or aggregate of the two; in other words, the inseparable Ens, which carries us out of the

* Aristot. De Animâ, II. 413, b. 11. *ἡ ψυχὴ τῶν εἰρημένων τούτων ἀρχή.*—II. 412, a. 5. *τίς ἂν εἴη κοινότατος λόγος αὐτῆς.*

† Aristot. De Animâ, II. 412, b. 7. *τὸν κηρὸν καὶ τὸ σχῆμα.*

domain of logic or abstraction into that of the concrete or reality.*

Aristotle farther recognizes, between these two logical correlates, a marked difference of rank. The Form stands first, the Matter second—not in time, but in notional presentation. The Form is higher, grander, prior in dignity and esteem, more Ens, or more nearly approaching to perfect entity; the Matter is lower, meaner, posterior in dignity, farther removed from that perfection. The conception of wax, plaster, wood, &c. without any definite or determinate shape, is confused and unimpressive: but a name, connoting some definite shape, at once removes this confusion, and carries with it mental pre-eminence, alike as to phantasm, memory, and science. In the logical hierarchy of Aristotle, Matter is the inferior and Form the superior;† yet neither of the two can escape from its relative character; Form requires matter for its correlate, and is nothing in itself or apart,‡ just as much as matter requires Form; though from the inferior

* Aristot. Metaphys. Z. 3, 1029, a. 1-30.; De Animâ, II. 1, 412, a. 6, 414, a. 15.

In the first book of the Physica, Aristotle pushes this analysis yet further, introducing three *principia* instead of two: 1. Form, 2. Matter, 3. Privation (of Form); he gives a distinct general name to the negation as well as to the affirmation; he provides a sign *minus* as counter-denomination to the sign *plus*. But he intimates that this is only the same analysis more minutely discriminated, or in a different point of view—*διὸ ἔστι μὲν ὡς δύο λεκτέον εἶναι τὰς ἀρχὰς, ἔστι δ᾽ὡς τρεῖς*—(Phys. I. 7, 190, b. 28).

Materia Prima (Aristotle says—Phys. I. 7, 191, a. 8) is "knowable only by analogy"—*i.e.* explicable only by illustrative examples: as the brass is to the statue, as the wood is to the couch, &c.; Natural Substances being explained from works of art, as is frequent with Aristotle.

† Aristot. Physic, I. 9, p. 192, a. 13-24; De Gener. Animal. II. 1, 728, a. 10. Matter and Form are here compared to the female and the male—to mother and father. Form is a cause operative, Matter a cause co-operative, though both are alike indispensable to full reality: with Form—*ἡ μὲν γὰρ ὑπομένουσα συναιτία τῇ μορφῇ τῶν γινομένων ἐστὶν ὥσπερ μήτηρ—ἀλλὰ τοῦτ᾽ ἔστιν ἡ ὕλη, ὥσπερ ἂν εἰ θῆλυ ἄῤῥενος καὶ αἰσχρὸν καλοῦ (ἐφίετο)*.—De Partibus Animalium, I. 1, 640, b. 30. *ἡ γὰρ κατα τὴν μορφὴν φύσις κυριωτέρα τῆς ὑλικῆς φύσεως*—p. 646, b. 1.

Metaphys., Z. 3, 1029, a. 6. *τὸ εἶδος τῆς ὕλης πρότερον καὶ μᾶλλον ὂν*—1039, a. 1.

See Schwegler's German Commentary, pp. 13-42-83—in the second volume of his edition of the Aristotelian Metaphysica.

‡ Aristot. Metaph., Z. 8,1033, b. 12, seq.; Θ. 3, 1047, a. 25.

dignity of matter, we find it more frequently described as the second or Correlatum, while Form is made to stand forward as the Relatum. For complete reality, we want the concrete individual, involving the implication of both; in regard to each of the constituents *per se*, no separate real existence can be affirmed, but only a nominal or logical separation.

This difference of rank between Matter and Form,—that the first is inferior and the last the superior,—is sometimes so much put in the foreground, that the two are conceived in a different manner and under other names, as Potential and Actual. Matter is the potential, imperfect, inchoate, which the supervening Form actualizes into the perfect and complete; a transition from half-reality to entire reality or act. The Potential is the undefined or indeterminate*—*what may be or may not be*—what is not yet actual, and may perhaps never become so, but is prepared to pass into actuality when the energizing principle comes to aid. In this way of putting the antithesis, the Potential is not so much *implicated* with the Actual as *merged* and suppressed to make room for the Actual; it is as a half-grown passing into a full-grown; being itself essential as a preliminary stage, in the order of logical generation.† The three logical divisions—

* Aristot. Metaphys., Θ. 8, 1050, b. 10. He says, p. 1048, a. 35, that this distinction between Potential and Actual cannot be defined, but can only be illustrated by particular examples, several of which he proceeds to enumerate. —Trendelenburg, observes (Note ad Aristot. De Animâ, p. 307)—"Δύναμις contraria adhuc in se inclusa tenet, ut in utrumque abire possit: ἐνέργεια alterum excludit."—Compare also ib. p. 302.—This *may or may not be*—is the widest and most general sense of the terms δύναμις and δυνατὸν, common to all the analogical or derivative applications that Aristotle points out as belonging to them. It is more general than that which he gives as the κύριος ὅρος τῆς πρώτης δυνάμεως ἀρχὴ—μεταβλητικὴ ἐν ἄλλῳ ἢ ᾗ ἄλλο —and ought seemingly to be itself considered as the κύριος ὅρος—Arist. Metaphys. Δ. 12, 1020, a. 5, with the comment of Bonitz, who remarks upon the loose language of Aristotle in this Chapter, but imputes to Aristotle a greater amount of contradiction than he seems to deserve.—(Bonitz, Comm. ad Metaphys., p. 256-393.)

† *Ens potentiâ* is a variety of Ens (Arist. Metaph. Δ. 7, 1007, b. 6), but an imperfect variety—it is ὂν ἀτελὲς, which may become matured into ὂν τέλειον, ὂν ἐντελεχείᾳ, or ἐνεργείᾳ.—(Metaphys., Θ. 1, 1045, a. 34.)

Matter is either remote or proximate, removed either by one stage or several stages from the σύνολον in which it culminates. Strictly speaking, none but proximate matter is said to exist δυνάμει. Alexander ad Metaph.

Matter, Form, and the resulting compound or concrete (*τὸ σύνολον, τὸ συνειλημμένον*), are here compressed into two—the Potential and the actualization thereof. Actuality (*ἐνέργεια, ἐντελέχεια*) coincides in meaning partly with the Form, partly with the resulting compound; the Form being so much exalted, that the distinction between the two is almost effaced.*

Two things are to be remembered respecting matter, in its Aristotelian (logical or ontological) sense. 1. It may be *body*, but it is not necessarily *body*.† 2. It is only intelligible as the Correlatum of Form; it can neither exist by itself, nor can it be known by itself (*i.e.* when taken out of that relativity). This deserves notice, because to forget the relativity of a relative word, and to reason upon it as if it were an absolute, is an oversight not unfrequent. Furthermore, each variety of matter has its appropriate Form, and each variety of Form its appropriate matter, with which it correlates. There are various stages or gradations of matter; from Materia Prima, which has no Form at all, passing upwards through successive partial developments to Materia Ultima; which last is hardly‡ distinguishable from Form or from Materia Formata.

Θ. 1049, a. 18,—*ἡ πόῤῥω ὕλη οὐ λέγεται δυνάμει· ὅτι οὐ παρωνυμιάζομεν τὰ πράγματα ἐκ τῆς πόῤῥω ἀλλ' ἐκ τῆς προσεχοῦς· λέγομεν γὰρ τὸ κιβώτιον ξύλινον ἐκ τῆς προσεχοῦς, ἀλλ' οὐ γηίνον ἐκ τῆς πόῤῥω.*

* Aristot. Metaphys., H. 1, 1042, a. 25, seq. He scarcely makes any distinction here between *ὕλη* and *δύναμις*, or between *μορφὴ* and *ἐνέργεια*; also Θ. 8, 1050, a. 15.

Alexander in his Commentary on this book (Θ. 1047, a. 30, p. 542, Bonitz's edit.) remarks that *ἐνέργεια* is used by Aristotle in a double sense; sometimes meaning *κίνησις πρὸς τὸ τέλος*; sometimes meaning the *τέλος* itself: comp. H. 3, 1043, a. 32; compare the commentary of Bonitz, p. 393.

† Aristot. Metaph., Z. 11, 1036, a. 9. *ἡ δ' ὕλη ἄγνωστος καθ' αὑτὴν. ὕλη δ' ἡ μὲν αἰσθητὴ, ἡ δὲ νοητή· αἰσθητὴ μὲν οἷον χαλκὸς καὶ ξύλον καὶ ὅση κινητὴ ὕλη, νοητὴ δὲ ἡ ἐν τοῖς αἰσθητοῖς ὑπάρχουσα μὴ ᾗ αἰσθητὰ, οἷον τὰ μαθηματικά*—1035, a. 7.

Physica. III. 6, 207, a. 25; De Generat. et Corrupt., I. 5, 320, b. 15-25.

‡ Aristot. De Animâ, II. 2, 414, a. 26. *ἑκάστου γὰρ ἡ ἐντελέχεια ἐν τῷ δυνάμει ὑπάρχοντι καὶ ἐν τῇ οἰκείᾳ ὕλῃ πέφυκεν ἐγγίνεσθαι.* Physica, II. 2, 194, b. 8.—*ἔτι τῶν πρός τι ἡ ὕλη· ἄλλῳ εἴδει ἄλλη ὕλη.*—Aristot. Metaph., H. 6, 1045, b. 18.—*ἔστι δ' ὥσπερ εἴρηται, καὶ ἡ ἐσχάτη ὕλη καὶ ἡ μορφὴ ταὐτὸ, καὶ δυνάμει, τὸ δὲ ἐνεργείᾳ.*—See upon this doctrine Schwegler's Commentary, pp. 100-154-173-240, of the second volume of his edition of the Metaphysica. Potentiality *ἐγγυτέρω καὶ πορρωτέρω.*—Arist. De Gener. Animal. II., 1, 735, a. 9; also De Cœlo, IV. 3, 310, b. 14.

The distinction above specified is employed by Aristotle in his exposition of the Soul. The Soul belongs to the Category of Substance or Essence (not to that of Quantity, Quality, &c.); but of the two points of view under which Essence may be presented, the Soul ranks with Form, not with Matter—with the Actual, not with the Potential. The Matter to which (as Correlatum) Soul stands related, is a natural Body (*i.e.* a body having within it an inherent principle of motion and rest) organized in a certain way, or fitted out with certain capacities and preparations to which Soul is the active and indispensable complement. These capacities would never come into actuality without the Soul; but, on the other hand, the range of actualities or functions in the Soul depends upon, and is limited by, the range of capacities ready prepared for it in the body. The implication of the two constitutes the living subject, with all its functions, active and passive. If the eye were an animated or living subject, seeing would be its Soul; if the carpenter's axe were living, cutting would be its Soul;* the Matter would be the lens or the iron in which this Soul is embodied. It is not indispensable, however, that all the functions of the living Subject should be at all times in complete exercise; the Subject is still living, even while asleep; the eye is still a good eye, though at the moment closed. It is enough if the functional aptitude exist as a dormant property, ready to rise into activity, when the proper occasions present themselves. This minimum of Form suffices to give living efficacy to the potentialities of Body; it is enough that a man, though now in a dark night and seeing nothing, will see as soon as the sun rises; or that he knows geometry, though he is not now thinking of a geometrical problem. This dormant possession is what Aristotle calls the First Entelechy or Energy, *i.e.* the lowest stage of Actuality, or the minimum of influence required to transform Potentiality into Actuality. The Aristotelian definition of Soul is thus—The First Entelechy of a natural organized Body, having life in potentiality.† It is all that is

* Aristot. De Animâ, II. 1, 412, b. 11. εἰ γάρ ἦν ὁ ὀφθαλμὸς ζῷον, ψυχὴ ἂν ἦν αὐτοῦ ἡ ὄψις· αὐτὴ γὰρ οὐσία ὀφθαλμοῦ ἡ κατὰ τὸν λόγον· ὁ δ' ὀφθαλμὸς ὕλη ὄψεως, ἧς ἀπολειπούσης οὐκέτ' ὀφθαλμὸς, πλὴν ὁμωνύμως, καθάπερ ὁ λίθινος καὶ ὁ γεγραμμένος.

† Aristot. De Animâ, II. 1, 412, a. 27. διὸ ἡ ψυχή ἐστιν ἐντελέχεια ἡ πρώτη σώματος φυσικοῦ δυνάμει ζωὴν ἔχοντος; τοιοῦτο δὲ ὃ ἂν ᾖ ὀργανικόν. Compare Metaphysica, VI., 1035, b. 15-27.

essential to the Soul; the second or higher Entelechy (actual exercise of the faculties) is not a constant or universal property.*

In this definition of the Soul, Aristotle employs his own Philosophia Prima to escape the errors committed by prior philosophers. He does not admit that the Soul is a separate Entity in itself; or that it is composed (as Empedokles and Demokritus had said) of corporeal elements, or (as Plato had said) of elements partly corporeal, partly logical and notional. He rejects the imaginary virtues of number, invoked by the Pythagoreans and Xenokrates; lastly, he keeps before him not merely man, but all the varieties of animated objects, to which his definition must be adapted. His first capital point is to put aside the alleged identity, or similarity, or sameness of elements, between Soul and Body; and to put aside equally any separate existence or substantiality of Soul. He effects both these purposes by defining them as essentially Relatum and Correlatum; the Soul, as the Relatum, is unintelligible and unmeaning without its Correlatum, upon which accordingly its definition is declared to be founded.

The real Animated Subject may be looked at either from the point of view of the Relatum or from that of the Correlatum; but though the two are thus logically separable, in fact and reality they are inseparably implicated; and if either of them be withdrawn, the Animated Subject disappears. "The soul (says Aristotle) is not any variety of body, but it cannot be without a body; it is not a body, but it is something belonging to or related to a body; and for this reason it is *in* a body, and in a body of such or such potentialities."† Soul is to Body, (we thus read) not as a compound of like elements,—nor as a type is to its copy, or *vice versa*—but as a Relatum to its Correlate; dependent upon the body for all its acts and manifestations, and bringing to

* Aristot. De Animâ, II. 2, 414, a. 9-15. The distinction here taken between the first or lower stage of Entelechy, and the second or higher stage, coincides substantially with the distinction in the Nikomachean Ethica and elsewhere between *ἕξις* and *ἐνέργεια*. See Topica, IV. 5, 125, b. 16; Ethic. Nikom., II., 1-5.

† Aristot. De Animâ, II. 2, 414, a. 20. *καὶ διὰ τοῦτο καλῶς ὑπολαμβάνουσιν οἷς δοκεῖ μητ' ἄνευ σώματος εἶναι μήτε σῶμά τι ἡ ψυχή· σῶμα μὲν γὰρ οὐκ ἔστι, σώματος δέ τι, καὶ διὰ τοῦτο ἐν σώματι ὑπάρχει, καὶ ἐν σώματι τοιούτῳ.* Compare Aristot. De Juventute et Senectute, c. 1, 467, b. 14.

consummation what in the body exists as potentiality only. Soul, however, is better than Body; and the Animated Being is better than the Inanimate by reason of its Soul.*

The animated subject is thus a form immersed or implicated in matter; and all its actions and passions are so likewise.† Each of these has its formal side, as concerns the Soul, and its material side, as concerns the Body. When a man or animal is angry, for example, this emotion is both a fact of the Soul and a fact of the Body; in the first of these two characters, it may be defined as an appetite for hurting some one who has hurt us; in the second of the two, it may be defined as an ebullition of the blood and heat round the heart.‡ The emotion, belonging to the animated subject or aggregate of soul and body, is a complex fact having two aspects, logically distinguishable from each other, but each correlating with and implying the other. This is true not only in regard to our passions, emotions, and appetites, but also in regard to our perceptions, phantasms, reminiscences, reasonings, efforts of attention in learning, &c. We do not say that the Soul weaves or builds (Aristotle observes§); we say that the Animated Subject, the aggregate of Soul and Body, *the man*, weaves or builds. So we ought also to say, not that the Soul feels anger, pity, love, hatred, &c., or that the soul learns, reasons, recollects, &c., but that the man with his soul does these things. The actual movement throughout these processes is not in the Soul, but in the Body; sometimes going through *to* the Soul (as in sensible perception), sometimes proceeding *from* the soul to the body (as in the case of reminiscence). All these processes are at once corporeal and psychical, pervading the whole animated subject, and having two aspects coincident and interdependent, though logically distinguishable. The perfect or imper-

* Aristot. De Generat. Animal., II. 1, 731, b. 29.

† Aristot. De Animâ, I. 1, 403, a. 25. *τὰ πάθη λόγοι ἔνυλοί εἰσι.* Compare II. 1, 412, b. 10-25, 413, a. 2.

‡ Aristot. De Animâ, I. 1, 403, a. 30.

§ Aristot. De Animâ, I. 4, 408, b. 12. *τὸ δὲ λέγειν ὀργίζεσθαι τὴν ψυχὴν ὅμοιον κἂν εἴ τις λέγοι τὴν ψυχὴν ὑφαίνειν ἢ οἰκοδομεῖν· βέλτιον γὰρ ἴσως μὴ λέγειν τὴν ψυχὴν ἐλεεῖν ἢ μανθάνειν ἢ διανοεῖσθαι, ἀλλὰ τὸν ἄνθρωπον τῇ ψυχῇ· τοῦτο δὲ μὴ ὡς ἐν ἐκείνῃ τῆς κινήσεως οὔσης, ἀλλ' ὅτε μὲν μέχρι ἐκείνης, ὅτε δ' ἀπ' ἐκείνης,* &c. Again, b. 30, *ὅτι μὲν οὖν οὐκ οἷόν τε κινεῖσθαι τὴν ψυχήν, φανερὸν ἐκ τούτων.*

fect discrimination by the sentient Soul, depends upon the good or bad condition of the bodily sentient organs; an old man that has become shortsighted, would see as well as before, if he could regain his youthful eye. The defects of the soul arise from defects in the bodily organism to which it belongs, as in cases of drunkenness or sickness; and this is not less true of the Nous, or intellective Soul, than of the sentient Soul.* Intelligence, as well as emotion, are phenomena, not of the bodily organism simply, nor of the Nous simply, but of the community or partnership of which both are members; and when intelligence gives way, this is not because the Nous itself is impaired, but because the partnership is ruined by the failure of the bodily organism.

Respecting the Nous (the theorizing Nous), we must here observe that Aristotle treats it as a separate kind or variety of Soul, with several peculiarities. We shall collect presently all that he says upon that subject, which is the most obscure portion of his psychology.

In regard to Soul generally, the relative point of view with Body as the Correlatum, is constantly insisted on by Aristotle; without such Correlatum, his assertions would have no meaning. But the relation between them is presented in several different ways. The Soul is the cause and principle of a living body;† by which is meant, not an independent and pre-existent something that brings the body into existence, but an immanent or in-dwelling influence which sustains the unity and guides the functions of the organism. According to the quadruple classification of Cause recognized by Aristotle—Formal, Material, Movent, and Final—the Body furnishes the Material Cause, while the Soul comprises all the three others; it is (as we have already seen) the Form in relation to the body as matter, but it is, besides, the Movent, inasmuch as it determines the local displacement as well as all the active functions of the Body—nutrition, growth, generation, sensation, &c.; lastly, it is also the Final Cause, since the maintenance and perpetuation of the same Form, in successive individuals, is the standing purpose

* Aristot. De Animâ, I. 4, 408, b. 26.—Compare a similar doctrine in the Timæus of Plato, p. 86, B.-D.

† Aristot. De Animâ, II. 4, 415, b. 9. ἔστι δ' ἡ ψυχὴ τοῦ ζῶντος σώματος αἰτία καὶ ἀρχή· ταῦτα δὲ πολλαχῶς λέγεται.

aimed at by each Body in the economy of Nature.* Under this diversity of aspect, Soul and Body are reciprocally integrant and complementary of each other, the real integer (the Living or Animated Body) including both.

Soul, in the Aristotelian point of view (what is common to all living bodies) comprises several varieties. But these varieties are not represented as forming a genus with co-ordinate species under it, in such manner that the counter-ordinate species, reciprocally excluding each other, are, when taken together, co-extensive with the whole genus—like Man and Brute in regard to animal. The varieties of Soul are distributed into successive stages gradually narrowing in extension and enlarging in comprehension; the first or lowest stage being co-extensive with the whole, but connoting only two or three simple attributes; the second, or next above, connoting all these and more besides, but denoting only part of the individuals denoted by the first; the third connoting all this and more, but denoting yet fewer individuals; and so on forward. Thus the concrete individuals called Living Bodies, include all plants as well as all animals; but the Form Soul (called Nutritive by Aristotle) corresponding thereto, connotes only nutrition, growth, decay, and generation of another similar individual.† In the second stage, plants are left out, but all animals remain; the Sentient Soul, belonging to animals, but not belonging to any plants, connotes all the functions and faculties of the Nutritive Soul, together with sensible perception (at least in its rudest shape) besides.‡ We proceed onward in the same direction, taking in additional faculties—the Movent, Appetitive, Phantastic (Imaginative), Noëtic (Intelligent) Soul, and thus diminishing the total of individuals denoted. But each higher variety of soul continues to possess all the faculties of the lower. Thus the Sentient Soul cannot exist without comprehending all the faculties of the Nutritive, though the Nutritive exists (in plants) without any

* Aristot. De Animâ, II. 4, 415, a. 28, b. 12.

† In the Aristotelian treatise De Plantis—p. 815, b. 15—it is stated that Empedokles, Anaxagoras, and Demokritus, all affirmed that plants had both intellect and cognition, up to a certain moderate point. We do not cite this treatise as the composition of Aristotle; but it is reasonably good evidence, in reference to the doctrine of these other philosophers.

‡ Aristot. De Animâ, I. 5, 411, b. 28.

admixture of the Sentient. Again, the Sentient Soul does not necessarily possess either memory, imagination, or intellect (Nous); but no soul can be either Imaginative or Noëtic, without being sentient as well as nutritive. The Noëtic Soul, as the highest of all, retains in itself all the lower faculties; but these are found to exist apart from it.*

We may remark here that the psychological classification of Aristotle proceeds in the inverse direction to that of Plato. In the Platonic Timæus, we begin with the grand soul of the Kosmos, and are conducted by successive steps of degradation to men, animals, plants; while Aristotle lays his foundation in the largest, most multiplied, and lowest range of individuals, carrying us by successive increase of conditions to the fewer and the higher.

The lowest or Nutritive soul, in spite of the small number of conditions involved in it, is the indispensable basis whereon all the others depend. None of the other Souls can exist apart from it.† It is the first constituent of the living individual—the implication of Form with Matter in a natural body suitably organized; it is the preservative of the life of the individual, with its aggregate of functions and faculties, and with the proper limits of size and shape that characterize the species;‡ it is moreover the preservative of perpetuity to the species, inasmuch as it prompts and enables each individual to generate and leave behind a successor like himself; such is the only way that an individual can obtain quasi-immortality, though all of them aspire to become immortal.§ This lowest soul is the primary cause of digestion and nutrition. It is cognate with the celestial heat, which is essential also as a co-operative cause; accordingly all animated bodies possess an inherent natural heat.‖

* Aristot. De Animâ, II. 2, 413, a. 25-30, b. 32; II. 3, 414, b. 30, 415, a. 10.

† Aristot. De Animâ, II. 4, 415, a. 24. *πρώτη καὶ κοινοτάτη δύναμίς ἐστι ψυχῆς, καθ' ἣν ὑπάρχει τὸ ζῆν ἅπασιν.* 415, b. 9. *τοῦ ζῶντος σώματος αἰτία καὶ ἀρχή.* III., 12, 434, a. 22-30, b. 24.—Aristot. De Respiratione, 8, 474, a. 30, b. 11.

‡ Aristot. De Animâ, II. 4, 416, a. 17.

§ Aristot. De Animâ, II. 4, 415, b. 2, 416, b. 25. *ἐπεὶ δ' ἀπὸ τοῦ τέλους ἅπαντα προσαγορεύειν δίκαιον, τέλος δὲ τὸ γεννῆσαι οἷον αὐτὸ, εἴη ἂν ἡ πρώτη ψυχὴ γεννητικὴ οἷον αὐτό.* Also De Generat. Animal. II. 1, 731, b. 33.

‖ Aristot. De Animâ, II. 4, 416, a. 10-18, b. 29.

We advance upwards now from the Nutritive Soul to that higher Soul which is at once Nutritive and Sentient; for Aristotle does not follow the example of Plato in recognizing three souls to one body, but assigns only one and the same soul, though with multiplied faculties and functions, to one and the same body. Sensible perception, with its accompaniments, forms the characteristic privilege of the animal as contrasted with the plant.* Sensible perception admits of many diversities, from the simplest and rudest tactile sensation, which even the lowest animals cannot be without, to the full equipment of five senses which Aristotle declares to be a maximum not susceptible of increase.† But the sentient faculty, even in its lowest stage, indicates a remarkable exaltation of the Soul in its character of Form. The Soul, *quâ* sentient and percipient, receives the Form of the Perceptum without the matter; whereas the nutritive Soul cannot disconnect the two, but receives and appropriates the nutrient substance, Form and Matter in one and combined.‡ Aristotle illustrates this characteristic feature of sensible perception by recurring to his former example of the wax and the figure. Just as wax receives from a signet the impression engraven thereon, whether the matter of the signet be iron, gold, stone, or wood; as the impression stamped has no regard to the matter, but reproduces only the figure engraven on the signet; the wax being only potential and undefined, until the signet comes to convert it into something actual and definite;§ so the percipient faculty in man is impressed by the substances in nature, not according to the matter of each, but according to the qualitative form of each. Such passive receptivity is the first and lowest form of sensation,‖

* Aristot. De Sensu et Sensili, c. 1, p. 436, b. 12. He considers sponges to have some sensation—Hist. Animal, I. 487, b. 9.

† Aristot. De Animâ, II. 3, 414, b. 2; III. 1, 424, b. 25, 415, a. 3; III. 13, 435, b. 15.

‡ Aristot. De Animâ, II. 12, 424, a. 32, b. 4. *διὰ τί ποτε τὰ φυτὰ οὐκ αἰσθάνεται, ἔχοντά τι μόριον ψυχικὸν καὶ πάσχοντά τι ὑπὸ τῶν ἁπτῶν; καὶ γὰρ ψύχεται καὶ θερμαίνεται· αἴτιον γὰρ τὸ μὴ ἔχειν μεσότητα, μηδὲ τοιαύτην ἀρχὴν οἵαν τὰ εἴδη δέχεσθαι τῶν αἰσθητῶν, ἀλλὰ πάσχειν μετὰ τῆς ὕλης.*

Themistius ad loc., p. 144, ed. Spengel. *πάσχει (τὰ φυτὰ) συνεισιούσης τῆς ὕλης τοῦ ποιοῦντος*, &c.

§ Aristot. De Animâ, II. 12, 424, a. 20.

‖ Aristot. De Animâ, II. 12, 424, a. 25. *αἰσθητήριον δὲ πρῶτον ἐν ᾧ ἡ τοιαύτη δύναμις*, &c.—III. 12, 434, a. 29.

not having any magnitude in itself, but residing in bodily organs which have magnitude, and separable from them only by logical abstraction. It is a potentiality, correlating with, and in due proportion to, the exterior Percipibile, which, when acting upon it, brings it into full actuality. The actuality of both (Percipiens and Perceptum) is one and the same, and cannot be disjoined in fact, though the potentialities of the two are distinct yet correlative; the Percipiens is not like the Percipibile originally, but becomes like it by being thus actualized.*

The Sentient Soul is communicated by the male parent in the act of generation,† and is complete from the moment of birth, not requiring a process of teaching after birth; the Sentient Subject becomes at once and instantly, in regard to sense, on a level with one that has attained a certain actuality of cognition, but which is not at the moment reflecting upon the Cognitum. Potentiality and Actuality are in fact distinguishable into lower and higher degrees; the Potential that has been actualized in a first or lower stage, is still a Potential relatively to higher stages of Actuality.‡ The Potential may be acted upon in two opposite ways; either by deadening and extinguishing it, or by developing and carrying it forward to realization. The Sentient Soul, when asleep or inert, requires a cause to stimulate it into actual seeing, or hearing; the Noëtic or Cognizant Soul, under like circumstances, must also be stimulated into actual meditation on its cognitum. But there is this difference between the two. The Sentient Soul communes with particulars; the Noëtic Soul with Universals. The Sentient Soul derives its stimulus

* Aristot. De Animâ, III. 2, 425, b. 25. ἡ δὲ τοῦ αἰσθητοῦ ενέργεια καὶ τῆς αἰσθήσεως ἡ αὐτὴ μέν ἐστι καὶ μία, τὸ δ' εἶναι οὐ ταὐτὸν αὐταῖς. —II. 5, 418, a. 3. τὸ δ' αἰσθητικὸν δυνάμει ἐστὶν οἷον τὸ αἰσθητὸν ἤδη ἐντελεχείᾳ—πάσχει μὲν οὖν οὐχ ὅμοιον ὂν, πεπονθὸς δ' ὡμοίωται καὶ ἔστιν οἷον ἐκεῖνο.—Also, 417, a. 7-14-20.

There were conflicting doctrines current in Aristotle's time; some said that for an agent to act upon a patient, there must be *likeness* between the two; others said that there must be *unlikeness*. Aristotle dissents from both, and adopts a sort of intermediate doctrine—415, a. 30, 416, a. 10.

† Aristot. De Gener. Animal., II. 5, 741, a. 14, b. 7; De Animâ, II. 5, 417, b. 17.

‡ Aristot. De Animâ, II. 5, 417, b. 18-31. See above, p. 623, note ‡.

The extent of Potentiality, or the partial Actuality, which Aristotle claims for the sentient Soul even at birth, deserves to be kept in mind: we shall contrast it presently with what he says about the Nous.

from without, and from some of the individual objects, tangible, visible, or audible; but the Noëtic Soul is put into action by the abstract and universal, which is in a certain sense *within* the Soul itself; so that a man can at any time meditate on what he pleases, but he cannot see or hear what he pleases, or anything except such visible or audible objects as are at hand.*

We have already remarked, that in many animals the Sentient Soul is little developed; being confined in some to the sense of Touch (which can never be wanting),† and in others to Touch and Taste. But even this minimum of Sense—though small, if compared with the variety of senses in man—is a prodigious step in advance of plants; it comprises a certain cognition, and within its own sphere it is always critical, comparing, discriminative.‡ The Sentient Soul possesses this discriminative faculty in common with the Noëtic Soul or Intelligence, though applied to different objects and purposes; and possesses such faculty, because it is itself a mean or middle term between the two sensible extremes of which it takes cognizance,—hot and cold, hard and soft, wet and dry, white and black, acute and grave, bitter and sweet, light and darkness, visible and invisible, tangible and intangible, &c. We feel no sensation at all when the object touched is exactly of the same temperature with ourselves, neither hotter nor colder; the Sentient Soul, being a mean between the two extremes, is stimulated to assimilate itself for the time to either of them, according as it is acted upon from without. It thus makes comparison of each with the other, and of both with its own mean.§ Lastly, the sentient faculty in the Soul is

* Aristot. De Animâ, II. 5, 417, b. 20-25; III. 3, 427, b. 18. *Αἴτιον δὲ ὅτι τῶν καθ' ἕκαστον ἡ κατ' ἐνέργειαν αἴσθησις, ἡ δ' ἐπιστήμη τῶν καθόλου· ταῦτα δ' ἐν αὐτῇ πως ἔστι τῇ ψυχῇ.*

† Aristot. De Animâ, III. 12, 434, b. 24. *φανερὸν ὅτι οὐχ οἷόν τε ἄνευ ἁφῆς εἶναι ζῷον.*

‡ Aristot. De Animâ, III. 9, a. 16. *τῷ κριτικῷ, ὃ διανοίας ἔργον ἐστὶ καὶ αἰσθήσεως.*—III. 3, 427, a. 20, 426, b. 10-15. De Generat. Animal., I. 23, 731, a. 32, b. 5; De Somno et Vigil., c. 1, 458, b. 2. The sentient faculty is called *δύναμιν σύμφυτον κριτικήν.*—Analyt. Poster., II. 19, p. 99, b. 34.

§ Aristot. De Animâ, II. 10, 422, a. 20; II. 421, b. 4, 11, 423, b. 31, 424, a. 10. *καὶ διὰ τοῦτο κρίνει τὰ αἰσθητὰ—τὸ γὰρ μέσον κριτικόν.*—III. 7, 431, a. 10. *ἔστι τὸ ἥδεσθαι καὶ λυπεῖσθαι τὸ ἐνεργεῖν τῇ αἰσθητικῇ μεσότητι πρὸς τὸ ἀγαθὸν ἢ κακόν, ᾗ τοιαῦτα.*—III. 13, 435, a. 21.

He remarks that plants have no similar *μεσότητα*—424, b. 1.

really one and indivisible, though distinguishable logically or by abstraction into different genera and species.* Of that faculty the central physical organ is the *heart*, which contains the congenital or animal spirit. (The Aristotelian psychology is here remarkable, affirming as it does the essential relativity of all phenomena of sense to the appreciative condition of the Sentient; as well as the constant implication of intellectual and discriminative comparison among them.)

All the objects generating sensible perception, are magnitudes.† Some perceptions are peculiar to one sense alone, as colour to the eye, &c. Upon these we never make mistakes directly; in other words, we always judge rightly what is the colour or what is the sound, though we are often deceived in judging what the thing coloured is, or where the sonorous object is.‡ There are, however, some perceivables not peculiar to any one sense alone, but appreciable by two or more; though chiefly and best, by the sense of vision; such are Motion, Rest, Number, Figure, Magnitude. Here the appreciation becomes less accurate, yet it is still made directly by sense.§ But there are yet other matters that, though not directly affecting sense, are perceived indirectly, or by way of accompaniment to what is directly perceived. Thus we see a white object; nothing else affecting our sense except its whiteness. Beyond this, however, we judge and declare, that the object so seen is the son of Diares. This is a judgment obtained indirectly, or by way of accompaniment; by *accident*, so to speak, inasmuch as the same does not accompany all sensations of white. It is here that we are most liable to error.‖

* Aristot. De Sensu et Sensili, c. 7, 140, a. 8-17; De Motu Animal., 10, 703, a. 15; De Somno et Vigil., c. 2, 455, a. 15-21-35, 456, a. 5; De Juventute et Senect., 467, b. 27, 469, a. 4-12; De Partibus Animalium, III. 656, a. 10-16, 657, b. 24.

† Aristot. De Sensu et Sensili, c. 7, 449, a. 20. *τὸ αἰσθητὸν πᾶν ἐστι μέγεθος.*

‡ Aristot. De Animâ, II. 6, 418, a. 10-15.

§ Aristot. De Sensu et Sensili, c. 1, 437, a. 8, c. 4, 442, b. 3-12. He says in this last passage, that the common perceivables are appreciable *at least by both sight and touch*—if not by all the senses.

‖ Aristot. De Animâ, II. 6, 418, a. 7-25. *λέγεται δὲ τὸ αἰσθητὸν τριχῶς, ὧν δύο μὲν καθ' αὑτά φαμεν αἰσθάνεσθαι, τὸ δὲ ἓν κατὰ συμβεβηκός.*—Also, III. 1, 425, a. 25; III. 3, 428, b. 18-25.

Among the five senses, Aristotle distinguishes two as operating by direct contact between Subject and Object (Touch, Taste); three as operating through an external intervening medium (Vision, Smell, Taste). He begins with Vision, which he regards as possessing most completely the nature and characteristics of a Sense.* The direct and proper object of vision is, colour. Now, colour operates upon the eye not immediately; for if the coloured object be placed in contact with the eye, there will be no vision; but by causing movements or perturbations in the external intervening medium, air or water, which affect the sense through an appropriate agency of their own.† This agency is, according to Aristotle, the Diaphanous or Transparent. When actual or in energy, the Transparent is called Light; when potential or in capacity only, it is called Darkness. The eye is of watery structure, apt for receiving these impressions.‡ It is the presence either of fire, or of something analogous to the celestial body, that calls forth the Diaphanous from the state of Potentiality into that of Actuality or Light; in which latter condition it is stimulated by colour. The Diaphanous, whether as Light or as Darkness, is a peculiar nature or accompaniment, not substantive in itself, but inherent chiefly in the First or Celestial Body, yet also in air, water, glass, precious stones, and in all bodies to a greater or less degree.§ The Diaphanous passes at once and simultaneously, in one place as well as in another, from Potentiality to Actu-

* Aristot. De Animâ, III. 3, 429, a. 2. *ἡ ὄψις μάλιστα αἴσθησίς ἐστιν.* —Also, Metaphysica, A. init.

† Aristot. De Animâ, II. 7, 419, a. 12-14-19; Aristot. De Sensu et Sensili, c. 3, 440, a. 18. *ὥστ' εὐθὺς κρεῖττον φάναι, τῷ κινεῖσθαι τὸ μεταξὺ τῆς αἰσθήσεως ὑπὸ τοῦ αἰσθητοῦ γίνεσθαι τὴν αἴσθησιν, ἀφῇ καὶ μὴ ταῖς ἀποῤῥοίαις.*—Ib. c. 2, p. 438, b. 5. *εἴτε φῶς εἴτ' ἀήρ ἐστι τὸ μεταξὺ τοῦ ὁρωμένου καὶτοῦ ὄμματος, ἡ διὰ τούτου κίνησίς ἐστιν ἡ ποιοῦσα τὸ ὁρᾷν.*

‡ Aristot. De Animâ, II. 7, 419, a. 9. *τοῦτο γὰρ ἦν αὐτῷ τὸ χρώματι εἶναι, τὸ κινητικῷ εἶναι τοῦ κατ' ἐνέργειαν διαφανοῦς· ἡ δ' ἐντελέχεια τοῦ διαφανοῦς φῶς ἐστίν.*—418, b. 12-17. *ὅταν ᾖ ἐντελεχείᾳ διαφανὲς ὑπὸ πυρος ἢ τοιούτου οἷον τὸ ἄνω σῶμα—πύρὸς ἢ τοιούτου τινὸς παρουσία ἐν τῷ διαφανεῖ.*

§ Aristot. De Animâ, II. 7, 418, b. 5; De Sensu et Sensili, c. 2, 438, a. 14, b. 7, c. 3, 439, a. 21, seq. *ὃ δὲ λέγομεν διαφανὲς, οὐκ ἔστιν ἴδιον ἀέρος ἢ ὕδατος, οὐδ' ἄλλου τῶν οὕτω λεγομένων σωμάτων, ἀλλά τίς ἐστὶ κοινὴ φύσις καὶ δύναμις, ἣ χωριστὴ μὲν οὐκ ἔστιν, ἐν τούτοις δ' ἐστὶ καὶ τοῖς ἄλλοις σώμασιν ἐνυπάρχει, τοῖς μὲν μᾶλλον, τοῖς δὲ ἧττον.*

ality—from Darkness to Light. Light does not take time to travel from one place to another, as sound and smell do.* The Diaphanous is not a body, nor effluvia from a body, nor any one of the elements; it is of an adjective character—a certain agency or attribute pervading or belonging to bodies, along with their extension.† Colour marks and defines the surface of the body *quâ* Diaphanous, as figure defines it *quâ* extended. Colour makes the Diaphanous itself visible, and its own varieties visible through the Diaphanous. Air and water are transparent throughout, though with an ill-defined superficial colour. White and black, as colours on solid bodies, correspond to the condition of light or darkness in air. There are some luminous objects visible in the dark, as fire, fungous matter, eyes, and scales of fish, &c., though they have no appropriate colour.‡ There are seven species or varieties of colours, but all of them proceed from white and black, blended in different proportions, or seen one through another; white and black are the two extremes, the other varieties being intermediate between them.

The same necessity for an intervening medium external to the Subject, as in the case of Vision, prevails also in the Senses of Hearing and Smell. If the audible or odorous object be placed in contact with its organ of Sense, there will be *no* hearing or smell. Whenever we hear or smell any object, there must be interposed between us and the object a suitable medium that shall be affected first; while the organ of Sense will be affected secondarily through that medium. Air is the medium in regard to Sound, both Air and Water in regard to Smell; but there seems besides (analogous to the Transparent in regard to Vision)

* Aristot. De Sensu et Sensili, c. 6, 446, a. 23, seq., b. 27, 447, b. 9. *τῷ εἶναι γάρ τι φῶς ἐστὶν, ἀλλ' οὐ κίνησίς τις.*—Empedokles affirmed that light travelling from the Sun reached the intervening space before it came to the earth; Aristotle contradicts him.

† Aristot. De Animâ, II. 7, 418, b. 19. *ἔστι δὲ τὸ σκότος στέρησις τῆς τοιαύτης ἕξεως ἐκ διαφανοῦς, ὥστε δῆλον ὅτι καὶ ἡ τούτου παρουσία φῶς ἦν.*—Aristot. De Sensu et Sensili, c. 3. *ἡ μὲν οὖν τοῦ φωτὸς φύσις ἐν ἀορίστῳ τῷ διαφανεῖ ἔστιν· τοῦ δ' ἐν τοῖς σώμασι διαφανοῦς τὸ ἔσχατον, ὅτι μὲν ἂν εἴη τι, δῆλον· ὅτι δὲ τοῦτο ἔστι τὸ χρῶμα, ἔκ τῶν συμβαινόντων φανερόν—ἔστι μὲν γὰρ ἐν τῷ τοῦ σώματος πέρατι, ἀλλ' οὔτι τὸ τοῦ σώματος πέρας, ἀλλὰ τὴν αὐτὴν φύσιν δεῖ νομίζειν, ἥπερ καὶ ἔξω χρωματίζεται, ταύτην καὶ ἐντός.*

‡ Aristot. De Animâ, II. 7, 419, a. 2-24; Aristot. De Sensu et Sensili, c. 4, 442, a. 21, seven colours.

a special agency called the Trans-Sonant, which pervades air and enables it to transmit Sound; and certainly another special agency called the Trans-Olfacient, which pervades both air and water, and enables them to transmit Smell.* (It seems thus that something like a Luminiferous Ether—extended, mobile, and permeating bodies, yet still incorporeal in itself—was an hypothesis as old as Aristotle; and one other Ether besides, analogous in property and purpose—an Odoriferous Ether; perhaps a third or Soniferous Ether, but this is less distinctly specified by Aristotle).

Sound, according to Aristotle, arises from the shock of two or more solid bodies communicated to the air. It implies local movement in one at least of those bodies. Many soft bodies are incapable of making sound; those best suited for it are such as metals, hard in structure, smooth in surface, hollow in shape. The blow must be smart and quick, otherwise the air slips away and dissipates itself before the sound can be communicated to it.† Sound is communicated through the air to the organ of hearing; the air is one Continuum (not composed of adjacent particles with interspaces), and a wave is propagated from it to the internal ear; which (*i.e.* the ear) contains some air enclosed in the sinuous ducts within the membrane of the tympanum, congenitally attached to the organ itself, and endued with a certain animation.‡ This internal air within the ear, excited by

* Aristot. De Animâ, II. 7, 419, a. 25-35; De Sensu et Sensili, c. 5, 442, b. 30; Themistius ad Aristot. De Animâ, II. 7-8, p. 115, Spengel. *τὸ διαφανὲς—τὸ διηχὲς—τὸ δίοσμον.* The two last names are not distinctly stated by Aristotle, but are said to have been first applied by Theophrastus after him. See the notes of Trendelenburg and Torstrick; the latter supposes Themistius to have had before him a fuller and better text of Aristotle than that which we now possess, which seems corrupt. In our present text, the Transparent as well as the Trans-olfacient Ether are clearly indicated; the Trans-sonant, not clearly.

† Aristot. De Animâ, II. 8, 419, b. 10-25. He calls air *ψαθυρὸς—εὔθρυπτος*—(420, a. 1-8). (*εὐδιαίρετος εὐόλισθος.* Themistius, p. 116, 117, Sp.—"quod facilé diffluit."—Trendelenburg, Comm., p. 384.) He says that for sonorous purposes, air ought to be *ἀθροῦν*—compact or dense: sound reverberates best from metals with smooth surface—420, a. 25.

‡ Aristot. De Animâ, II. 8, 419, b. 34, 420, a. 5. *οὗτος δ' (ὁ ἀὴρ) ἐστὶν ὁ ποιῶν ἀκούειν, ὅταν κινηθῇ συνεχὴς καὶ εἷς—ψοφητικὸν μὲν οὖν τὸ κινητικὸν ἑνὸς ἀέρος συνεχείᾳ μέχρις ἀκοῆς. ἀκοῇ δὲ συμφυὴς ἀήρ· διὰ δὲ τὸ ἐν ἀέρι εἶναι, κινουμένου τοῦ ἔξω τὸ εἴσω κινεῖ. διόπερ*

the motion propagated from the external ear, causes hearing. The ear is enabled to appreciate accurately the movements of the external air, because it has itself little or no movement within. We cannot hear with any other part of the body; because it is only in the ear that nature has given us this stock of internal air. If water gets into the ear, we cannot hear at all; because the wave generated in the air without, cannot propagate itself within. Nor can we hear if the membrane of the ear be disordered; any more than we can see when the membrane of the eye is disordered.*

Voice is a kind of sound peculiar to animated beings; yet not belonging to all of them, but only to those that inspire the air. Nature employs respiration for two purposes; the first, indispensable to animal life—that of cooling and tempering the excessive heat of the heart and its adjacent parts; the second, not indispensable to life, yet most valuable to the higher faculties of man—significant speech. The organ of respiration is the larynx; a man cannot speak either when inspiring or expiring, but only when retaining and using the breath within. The Soul in those parts, when guided by some phantasm or thought, impels the air within against the walls of the trachea, and this shock causes vocal sounds.†

Aristotle seems to have been tolerably satisfied with the above explanations of Sight and Hearing; for in approaching the Sense of Smell with the Olfacients, he begins by saying that it is less definable and explicable. Among the five senses, Smell stands

οὐ πάντῃ τὸ ζῷον ἀκούει, οὐδὲ πάντῃ διέρχεται ὁ ἀήρ· οὐ γὰρ πάντῃ ἔχει ἀέρα τὸ κινησόμενον μέρος καὶ ἔμψυχον—διὰ τὰς ἕλικας—420, a. 13.

The text of this passage is not satisfactory. It has been much criticised as well as amended by Torstrick—see his Comment., p. 148 or 151. We cannot approve his alteration of ἔμψυχον into ἔμψοφον.

* Aristot. De Animâ, II. 8, 420, a. 10. ὁ δ' ἐν τοῖς ὠσὶν ἐγκατῳκοδόμηται πρὸς τὸ ἀκίνητος εἶναι, ὅπως ἀκριβῶς αἰσθάνηται πάσας τὰς διαφορὰς τῆς κινήσεως.—420, a. 14. οὐδ' (ἀκούομεν) ἂν ἡ μῆνιγξ κάμῃ, ὥσπερ τὸ ἐπὶ τῇ κόρῃ δέρμα ὅταν κάμῃ.

† Aristot. De Animâ, II. 8, 420, b. 5-16-25-32, 421, a. 2. ὥστε ἡ πληγὴ τοῦ ἀναπνεομένου ἀέρος ὑπὸ τῆς ἐν τούτοις τοῖς μορίοις ψυχῆς φωνή ἐστιν. Οὐ γὰρ πᾶς ζῴου ψόφος φωνὴ, καθαπερ εἴπομεν, (ἔστι γὰρ καὶ τῇ γλώττῃ ψοφεῖν καὶ ὡς οἱ βήττοντες) ἀλλὰ δεῖ ἔμψυχόν τε εἶναι τὸ τύπτον καὶ μετὰ φαντασίας τινός· σημαντικὸς γὰρ δή τις ψόφος ἐστιν ἡ φωνὴ· καὶ οὐ τοῦ ἀναπνεομένου ἀέρος, ὥσπερ ἡ βὴξ, ἀλλὰ τούτῳ τύπτει τὸν ἐν τῇ ἀρτηρίᾳ πρὸς αὐτήν.

intermediate between the two (Taste and Touch) that operate by direct contact, and the other two (Sight and Hearing) that operate through an external medium. Man is below other animals in this sense; he discriminates little in smells except the pleasurable and the painful.* His taste, though analogous in many points to smell, is far more accurate and discriminating, because taste is a variety of touch; and in respect to touch, man is the most discriminating of all animals. Hence his great superiority to them in practical wisdom. Indeed the marked difference of intelligence between one man and another, turns mainly upon the organ of touch; men of hard flesh (or skin) are by nature dull in intelligence, men of soft flesh are apt and clever.† The classifying names of different smells are borrowed from the names of the analogous tastes to which they are analogous—sweet, bitter, tart, dry, sharp, smooth, &c.‡ Smells take effect through air as well as through water; by means of a peculiar agency or accompaniment (mentioned above, called the Trans-Olfacient) pervading both one and the other. It is peculiar to man that he cannot smell except when inhaling air in the act of inspiration; any one may settle this for himself by making the trial.§ But fishes and other aquatic animals, who never inhale air, can smell in the water; and this proves that the trans-olfacient agency is operative to transmit odours not less in water than in air.|| We know that the sense of smell in these aquatic animals is the same as it is in man, because the same strong odours that are destructive to man are also destructive to them.¶ Smell is the parallel, and in a certain sense the antithesis of taste; smell is of the dry, taste is

* Aristot. De Animâ, II. 9, 421, a. 7-12; Aristot. De Sensu et Sensili, c. 5, 445, a. 6, c. 4, 441, a. 1; De Partibus Animal., II. 2. 656, a. 31, 657, a. 9.

† Aristot. De Animâ, II. 9, 421, a. 17-27. *κατὰ δὲ τὴν ἁφὴν πολλῷ τῶν ἄλλων ζώων διαφερόντως ἀκριβοῖ (ὁ ἄνθρωπος)· διὸ καὶ φρονιμώτατόν ἐστι τῶν ζώων. σημεῖον δὲ τὸ καὶ ἐν τῷ γένει τῶν ἀνθρώπων παρὰ τὸ αἰσθητήριον τοῦτο εἶναι εὐφυεῖς καὶ ἀφυεῖς, παρ' ἄλλο δὲ μηδέν· οἱ μὲν γὰρ σκληρόσαρκοι ἀφυεῖς τὴν διάνοιαν, οἱ δὲ μαλακόσαρκοι εὐφυεῖς.*

‡ Aristot. De Animâ, II. 9, 421, a. 27-32.

§ Aristot. De Animâ, II. 9, 421, b. 9-19. *τὸ ἄνευ τοῦ ἀναπνεῖν μὴ αἰσθάνεσθαι, ἴδιον ἐπὶ τῶν ἀνθρώπων· δῆλον δὲ πειρωμένοις.* He seems to think that this is not true of any animal other than man.

|| Aristot. De Sensu et Sensili, c. 5, 443, a. 3-31, 444, b. 9.

¶ Aristot. De Animâ, II. 9, 421, b. 24. He instances brimstone, *ἄσφαλτος*, &c.

of the moist; the olfactory matter is a juicy or sapid dryness, extracted or washed out from both air and water by the trans-olfacient agency, and acting on the sensory potentialities of the nostrils.* This olfactory inhalation is warm as well as dry. Hence it is light, and rises easily to the brain, the moisture and coldness of which it contributes to temper; this is a very salutary process, for the brain is the wettest and coldest part of the body, and requiring warm and dry influences as a corrective. It is with a view to this correction that Nature has placed the olfactory organ in such close proximity to the brain.† There are two kinds of olfactory impressions; one of them akin to the sense of taste—odour and savour going together—an affection (to a great degree) of the nutritive soul; so that the same odour is agreeable when we are hungry, disagreeable when our hunger is fully satisfied. This first kind of impressions is common to men with other animals; but there is a second, peculiar to man, and disconnected from the sense of taste:—viz., the scent of flowers, unguents, &c., which are agreeable or disagreeable constantly, and *per se*.‡ Nature has assigned this second kind of odours as a privilege to man, because his brain, being so large and moist, requires to be tempered by an additional stock of drying and warming olfactory influence.

Taste is a variety of touch, and belongs to the lower or

* This is difficult to understand, but it seems to be what Aristotle here means—De Animâ, II. 9, 422, a. 6. *ἔστι δ' ἡ ὀσμὴ τοῦ ξηροῦ, ὥσπερ ὁ χυμὸς τοῦ ὑγροῦ· τὸ δ' ὀσφραντικὸν αἰσθητήριον δυνάμει τοιοῦτον.*—De Sensu et Sensili, c. 5, 443, a. 1-9. *ἔστι δ' ὀσφραντὸν οὐχ ᾗ διαφανὲς, ἀλλ' ᾗ πλυντικὸν καὶ ῥυπτικὸν ἐγχύμου ξηρότητος—ἡ ἐν ὑγρῷ τοῦ ἐγχύμου ξηροῦ φύσις ὀσμὴ, καὶ ὀσφραντὸν τὸ τοιοῦτον· ὅτι δ' ἅπαν χυμοῦ ἔστι τὸ πάθος, δῆλον ἐκ τῶν ἐχόντων καὶ μη ἐχόντων ὀσμὴν,* &c. Also, 443, b. 3-7.

In the Treatise De Sensu et Sensili, there is one passage (c. 2, 438, b. 24), wherein Aristotle affirms that smell is *καπνώδης ἀναθυμίασις, ἐκ πυρός*; but we also find a subsequent passage (c. 5, 443, a. 21, seq.) where he cites that same doctrine as the opinion of others, but distinctly refutes it.

† Aristot. De Sensu et Sensili, c. 5, 444, a. 10-22-25, b. 1. *ἡ γὰρ τῆς ὀσμῆς δύναμις θερμὴ τὴν φύσιν ἐστίν.*

‡ Aristot. De Sensu et Sensili, c. 5, 443, b. 17, 444, a. 6-15-30. *ἴδιον δὲ τῆς τοῦ ἀνθρώπου φύσεως ἔστι τὸ τῆς ὀσμῆς τῆς τοιαύτης γένος διὰ τὸ πλεῖστον ἐγκέφαλον καὶ ὑγρότατον ἔχειν τῶν ζώων ὡς κατὰ μέγεθος.*

Plato also reckons the pleasures of smell among the pure and admissible pleasures—(Philebus, p. 51 E.; Timæus, p. 65 A., 67 A.)

Nutritive Soul, as a guide to the animal in seeking or avoiding different sorts of food. The Object of Taste is essentially liquid, often strained and extracted from dry food by warmth and moisture. The primary manifestation of this sensory phenomenon is the contrast of Drinkable and Undrinkable.* The organ of Taste, the tongue, is a mean between dryness and moisture; when either of these is in excess, the organ is disordered. Among the varieties of taste, there are two fundamental contraries—as in colour, sound, and the objects of the other senses except touch—from which the other contrasts are derived. These fundamentals in taste are sweet and bitter; corresponding to white and black, acute and grave, in colours and sounds. The sense of taste is potentially sweet or bitter; the gustable object is what makes it sweet or bitter in actuality.†

The sense of Touch, in which man surpasses all other animals, differs from the other senses by not having any two fundamental contraries giving origin to the rest, but by having various contraries alike fundamental. It is thus hardly one sense, but an aggregate of several senses. It appreciates the elementary differences of body *quâ* body—hot, cold, dry, moist, hard, soft, &c. It is a mean between each of these two extremes; being potentially either one of them, and capable of being made to assimilate itself actually to either.‡ In this sense, the tangible object operates when in contact with the skin; and, as has been already said, much of the superiority of man depends upon his superior fineness and delicacy of skin.§ Still Aristotle remarks that the true organ of touch is not the skin or flesh, but something interior to the flesh. This last serves only as a peculiar medium. The fact that the sensation arises when the

* Aristot. De Animâ, II. 10, 422, a. 30-33; De Sensu et Sensili, c. 1, 436, b. 15, 4, 441, b. 18. *διὰ τοῦ ξηροῦ καὶ γεώδους διηθοῦσα (ἡ φύσις) καὶ κινοῦσα τῷ θερμῷ ποιόν τι τὸ ὑγρὸν παρασκευάζει, καὶ ἔστι τοῦτο χυμὸς τὸ γιγνόμενον ὑπὸ τοῦ εἰρημένου ξήροῦ πάθος ἐν τῷ ὑγρῷ.*—b. 24. *οὐ παντὸς ξηροῦ ἀλλὰ τοῦ τροφίμου.*

† Aristot. De Animâ, II. 10, 422, b. 5-15; II. 11, 422, b. 23. *πᾶσα αἴσθησις μιᾶς ἐναντιώσεως εἶναι δοκεῖ*, &c.

‡ Aristot. De Animâ, II. 11, 422, b. 17-25, 423, b. 5-27, a. 424, a. 3-10.

§ Aristot. Histor. Animal., I. 15, 494, b. 17. Man is *λεπτοδερμότατος τῶν ζώων* (Aristot. De Partib. Animal. II. 657, b. 2), and has the tongue also looser and softer than any of them, most fit for variety of touch (660, a. 20) as well as for articulate speech.

object touches our skin, does not prove that the skin is the true organ; for if there existed a thin exterior membrane surrounding our bodies, we should still feel the same sensation. Moreover, the body is not in real contact with our skin, though it appears to be so; there is a thin film of air between the two, though we do not perceive it; just as when we touch an object under water, there is a film of water interposed between, as is seen by the wetness of the finger.* The skin is, therefore, not the true organ of touch, but a medium between the object and the organ; and this sense does in reality agree with the other senses in having a certain medium interposed between object and organ. But there is this difference; in touch, the medium is close to and a part of ourselves; in sight and hearing, it is exterior to ourselves, and may extend to some distance. In sight and hearing, the object does not affect us directly; it affects the external medium, which again affects us. But in touch, the object affects, at the same time and by the same influence, both the medium and the interior organ; like a spear that, with the same thrust, pierces the warrior's shield and wounds the warrior himself.† Apparently, therefore, the true organ of touch is something interior, and skin and flesh is an interposed medium.‡ But what this interior organ is, Aristotle does not more particularly declare. He merely states it to be in close and intimate communication with the great central focus and principle of all sensation—the heart;§ more closely connected with the heart

* Aristot. De Animâ, II. 11, 422, b. 25-32.

† Aristot. De Animâ, II. 11, 423, a. 5-17. *διαφέρει τὸ ἁπτὸν τῶν ὁρατῶν καὶ τῶν ψοφητικῶν ὅτι ἐκείνων μὲν αἰσθανόμεθα τῷ τὸ μεταξὺ ποιεῖν τι ἡμᾶς, τῶν δὲ ἁπτῶν οὐχ ὑπὸ τοῦ μεταξὺ ἀλλ' ἅμα τῷ μεταξὺ, ὥσπερ ὁ δι' ἀσπιδὸς πληγείς· οὐ γὰρ ἡ ἀσπὶς πληγεῖσα ἐπάταξεν, ἀλλ' ἅμ' ἄμφω συνέβη πληγῆναι.*

This analogy, of the warrior pierced at the same time with his shield, illustrates Aristotle's view of the eighth Category—*Habere:* of which he gives *ὥπλισται* as the example. He considers a man's clothes and defensive weapons as standing in a peculiar relation to him, like a personal appurtenance, and almost as a part of himself. It is under this point of view that he erects *Habere* into a distinct Category.

‡ Aristot. De Animâ, II. 11, 423, b. 23-26. *ἦ καὶ δῆλον ὅτι ἐντὸς τὸ τοῦ ἁπτοῦ αἰσθητικόν—τὸ μεταξὺ τοῦ ἁπτικοῦ ἡ σάρξ.*

§ Aristot. De Partibus Animal., II. 10, 656, a. 30; De Vitâ et Morte, c. 3, 469, a. 12; De Somno et Vigil., c. 2, 455, a. 23; De Sensu et Sensili, c. 2, 439, a. 2.

(he appears to think) than any of the other organs of sense, though all of them are so connected more or less closely.

Having gone through the five senses *seriatim*, Aristotle offers various reasons to prove that there neither are, nor can be, more than five; and then discusses some complicated phenomena of sense. We perceive *that* we see or hear;* do we perceive this by sight or by hearing? and if not, by what other faculty? † Aristotle replies by saying that the act of sense is one and the same, but that it may be looked at in two different points of view. We see a coloured object; we hear a sound: in each case the act of sense is one; the energy or actuality of the Visum and Videns, of the Sonans and Audiens, is implicated and indivisible. But the potentiality of the one is quite distinct from the potentiality of the other, and may be considered as well as named apart.‡ When we say—I perceive *that* I see—we look at the same act of vision from the side of the Videns; the Visum being put out of sight as the unnoticed Correlate. This is a mental fact distinct from, though following upon, the act of vision itself. Aristotle refers it rather to that general sentient soul or faculty, of which the five senses are partial and separate manifestations, than to the sense of Vision itself.§ He thus considers what would now be termed *consciousness of a sensation*, as being merely the subjective view of the sensation, distinguished by abstraction from the objective.

It is the same general sentient faculty, though diversified and logically distinguishable in its manifestations, that enables us to conceive many sensations as combined in one; and to compare or discriminate sensations belonging to different senses.||

White and sweet are perceived by two distinct senses, and at

* In modern psychology, the language would be—"We *are conscious* that we see or hear." But Sir William Hamilton has remarked that the word Consciousness has no equivalent usually or familiarly employed, in the Greek psychology.

† Aristot. De Animâ, III. 2, 425, b. 14.

‡ Aristot. De Animâ, III. 2, 425, b. 26, 426, a. 16-19.

§ Aristot. De Somno et Vigil., c. 2, 455, a. 12-17; Aristot. De Animâ, III. 2, with Torstrick's note, p. 166, and the exposition of Alexander of Aphrodisias therein cited. These two passages of Aristotle are to a certain extent different, yet not contradictory, though Torstrick supposes them to be so.

|| Aristot. De Sensu et Sensili, c. 7, 449, a. 9-20.

two distinct moments of time; but they must be compared and discriminated by one and the same sentient or cogitant act, and at one moment of time.* This mental act, though in itself indivisible, has yet two aspects, and is thus in a certain sense divisible; just as a point taken in the middle of a line, while indivisible in itself, may be looked upon as the closing terminus of one-half of the line, and as the commencing terminus of the other half. The comparison of two different sensations or thoughts is thus one and the same mental fact, with two distinguishable aspects.†

Aristotle devotes a chapter to the enquiry—whether we can perceive two distinct sensations at once (*i.e.*, in one and the same moment of time). He decides that we cannot; that the sentient Soul or faculty is one and indivisible, and can only have a single energy or actuality at once.‡ If two causes of sensation are operative together, and one of them be much superior in force, it will render us insensible to the other. He remarks that when we are preoccupied with loud noise, or with deep reflection, or with intense fright, visual objects will often pass by us unseen and unnoticed.§ Often the two simultaneous sensations will combine or blend into one compound, so that we shall feel neither of them purely or separately.‖ One single act of sensational energy may however have a double aspect; as the same individual object may be at once white and sweet, though its whiteness and its sweetness are logically separable.¶

To the sentient soul, even in its lowest manifestations, belong

* Aristot. De Animâ, III. 2, 426, b. 18-12. *οὔτε δὴ κεχωρισμένοις ἐνδέχεται κρίνειν ὅτι ἕτερον το γλυκὺ τοῦ λευκοῦ, ἀλλὰ δεῖ ἑνί τινι ἄμφω δῆλα εἶναι—δεῖ δὲ τὸ ἓν λέγειν ὅτι ἕτερον· ἕτερον γὰρ τὸ γλυκὺ τοῦ λευκοῦ—ἀχώριστον καὶ ἐν ἀχωρίστῳ χρόνῳ.*—b. 29, also III. 7, 431, a. 20.

† Aristot. De Animâ, III. 2, 427, a. 10-14. *ὥσπερ ἣν καλοῦσί τινες στιγμὴν, ᾗ μιά καὶ ᾗ δύο, ταύτῃ καὶ ἀδιαίρετος καὶ διαιρέτη· ᾗ μὲν οὖν ἀδιαίρετον, ἓν τὸ κρῖνόν ἐστι καὶ ἅμα, ᾗ δὲ διαίρετον ὑπάρχει, οὐχ ἕν· δὶς γὰρ τῷ αὐτῷ χρῆται σημείῳ ἅμα.*

It is to be remarked that in explaining this mental process of comparison, Aristotle, three several times, applies it both to *αἴσθησις* and to *νόησις* 426, b. 22-31, 427, a. 9.

‡ Aristot. De. Sensu et Sensili, c. 7, 449, a. 8-17.

§ Aristot. De Sensu et Sensili, c. 7, 447, a. 15.

‖ Aristot. De Sensu et Sensili, c. 7, 447, b. 12-20.

¶ Aristot. De Sensu et Sensili, c. 7, 449, a. 14-18.

the feelings of pleasure and pain, appetite and aversion.* The movements connected with these feelings, as with all sensation, begin and close with the central organ—the heart.† Upon these are consequent the various passions and emotions; yet not without certain faculties of memory and phantasy accompanying or following the facts of sense.

Aristotle proceeds by gradual steps upward from the sentient Soul to the Noëtic (cogitant or intelligent) Soul—called in its highest perfection, Nous. While refuting the doctrine of Empedokles, Demokritus, and other philosophers, who considered cogitation or intelligence to be the same as sensible perception, and while insisting upon the distinctness of the two as mental phenomena,‡ he recognizes the important point of analogy between them, that both of them include judgment and comparison; and he describes an intermediate stage called phantasy or imagination, forming the transition from the lower of the two to the higher. We have already observed that in the Aristotelian psychology, the higher functions of the Soul presuppose and are built upon the lower as their foundation, though the lower do not necessarily involve the higher. Without nutrition, there is no sense; without sense, there is no phantasy; without phantasy, there is no cogitation or intelligence.§ The higher psychical phenomena are not identical with the lower, yet neither are they independent thereof; they presuppose the lower as a part of their conditions. Here, and indeed very generally elsewhere, Aristotle has been careful to avoid the fallacy of confounding or identifying the conditions of a phenomenon with the phenomenon itself. (Mill's System of Logic, Book V. ch. 3, § 8.)

He proceeds to explain Phantasy or the Phantastic department of the Soul—the Phantasms that belong to it. It is not sensible perception, nor belief, nor opinion, nor knowledge, nor cogitation. Our dreams, though affections of the Sentient

* Aristot. De Animâ, II. 3, 414, b. 3-15; III. 7, 431, a. 9; De Somno et Vigil., c. 1, 454, b. 29.

† Aristot. De Partibus Animalium, III. 4, 666, a. 12.

‡ Aristot. De Animâ, III. 3, 427, a. 25.

§ Aristot. De Animâ, III. 3, 427, b. 15. *φαντασία γὰρ ἕτερον καὶ αἰσθήσεως καὶ διανοίας.*—III. 7, 431, a. 16. *οὐδέποτε νοεῖ ἄνευ φαντάσματος ἡ ψυχή.*—De Memoriâ et Reminiscent. c. 1, 449, b. 31. *νοεῖν οὐκ ἔστιν ἄνευ φαντάσματος.*

Soul, are really phantasms in our sleep, when there is no visual sensation ; even when awake, we have a phantasm of the Sun, as of a disk one foot in diameter—though we *believe* the Sun to be larger than the Earth.* Many of the lower animals have sensible perception without any phantasy ; even those among them that have phantasy, have no opinion ; for opinion implies faith, persuasion, and some rational explanation of that persuasion —to none of which does any animal attain.† Phantasy is an internal movement of the animated being (body and soul in one) ; belonging to the Sentient Soul, not to the Cogitant or Intelligent ; not identical with the movement of sense, but continued from, or produced by that, and by that alone ; accordingly, similar to the movement of sense and relating to the same matters.‡ Since our sensible perceptions may be either true or false, so also may be our phantasms. And since these phantasms are not only like our sensations, but remain standing in the soul long after the objects of sense have passed away, they are to a great degree the determining causes both of action and emotion. They are such habitually to animals, who are destitute of Nous ; and often even to intelligent men, if the Nous be overclouded by disease or drunkenness.§

In the Chapter now before us, Aristotle is careful to discriminate Phantasy from several other psychological phenomena wherewith it is liable to be confounded. But we remark with some surprise, that neither here, nor in any other part of his general Psychology, does he offer any exposition of Memory, the phenomenon more nearly approaching than any other to Phantasy. He supplied the deficiency afterwards by the short but valuable tract on Memory and Reminiscence ; wherein he recognizes, and refers to, the more general work on Psychology. Memory bears on the past, as distinguished both from the present and

* Aristot. De Animâ, III. 3, 428, a. 5, b. 3 ; De Somno et Vig., c. 2, 456, a. 25. *κινοῦνται δ' ἔνιοι καθεύδοντες καὶ ποιοῦσι πολλὰ ἐγρηγορικά, οὐ μέντοι ἄνευ φαντάσματος καὶ αἰσθήσεώς τινος· τὸ γὰρ ἐνύπνιόν ἐστιν αἴσθημα τρόπον τινά.*—Ibid., c. 1, 454, b. 10.

† Aristot. De Animâ, III. 3, 428, a. 10-22-25.

‡ Aristot. De Animâ, III. 3, 428, b. 10-15 ; De Somniis, c. 1, 459, a. 15.

§ Aristot. De Animâ, III. 3, 428, b. 17. *καὶ πολλὰ κατ' αὐτὴν* (*i. e. κατὰ τὴν φαντασίαν*) *καὶ ποιεῖν καὶ πάσχειν τὸ ἔχον.*—III. 3, 429, a. 5. *καὶ διὰ τὸ ἐμμένειν καὶ ὁμοίας εἶναι* (*τὰς φαντασίας*) *ταῖς αἰσθήσεσι, πολλὰ κατ' αὐτὰς πράττει τὰ ζῷα*, &c.

future. Memory and Phantasy are in some cases so alike, that we cannot distinguish clearly whether what is in our minds is a remembrance or a phantasm.* Both of them belong to the same psychological department—to the central Sentient principle, and not to the cogitant or intelligent Noûs. Memory as well as Phantasy are continuations, remnants, or secondary consequences, of the primary movements of sense; what in itself is a phantasm, may become an object of remembrance directly and *per se;* matters of cogitation, being included or implicated in phantasms, may also become objects of remembrance, indirectly and by way of accompaniment.† We can remember our prior acts of cogitation and demonstration; we can remember that, a month ago, we demonstrated the three angles of a triangle to be equal to two right angles; but as the original demonstration could not be carried on without our having before our mental vision the phantasm of some particular triangle, so neither can the remembrance of the demonstration be made present to us without a similar phantasm.‡ In acts of remembrance, we have a conception of past time, and we recognize what is now present to our minds as a copy of what has been formerly present to us, either as perception of sense or as actual cognition;§ while in phantasms, there is no conception of past time, nor any similar recognition, nor any necessary reference to our own past mental states; the phantasm is looked at by itself, and not as a copy. This is the main point of distinction between phantasm and remembrance;‖ what is remembered is a present phantasm assimilated to an impression of the past. Some of the superior animals possess both memory and phantasy. But other animals have neither; their sensations disappear, they

* Aristot. De Memor. et Remin., c. 1, 451, a. 5, 449, a. 10.

† Aristot. De Memor. et Remin., c. 1, 450, a. 23. *τίνος μὲν οὖν τῶν τῆς ψυχῆς μορίων ἔστιν ἡ μνήμη, φανερὸν ὅτι οὗπερ καὶ ἡ φαντασία· καὶ ἔστι μνημονευτὰ καθ' αὑτὰ μὲν ὅσα ἐστί φανταστά, κατὰ συμβεβηκὸς δ' ὅσα μὴ ἄνευ φαντασίας.*

‡ Aristot. De Memor. et Rem., c. 1, 449, b. 20-450, a. 12.

§ Aristot. De Memor, et Rem., c. 1, 449, b. 22. *ἀεὶ γὰρ ὅταν ἐνεργῇ κατὰ τὸ μνημονεύειν, οὕτως ἐν τῇ ψυχῇ λέγει, ὅτι πρότερον τοῦτο ἤκουσεν ἢ ᾔσθετο ἢ ἐνόησεν.*—452, b. 28.

‖ Aristot. De Memor. et Rem., c. 1, 450, a. 28, b. 30, 451, a. 15. *τὸ μνημονεύειν, ὡς εἰκόνος οὗ φάντασμα, ἕξις.* Themistius ad Aristot. De Memoriâ, p. 240, ed. Spengel.

have no endurance; while endurance is the basis both of phantasy and memory.*

But though some animals have Memory, no animal except man has Reminiscence. Herein man surpasses them all.† Aristotle draws a marked distinction between the two; between the (memorial) retentive and reviving functions, when working unconsciously and instinctively, and the same two functions, when stimulated and guided by a deliberate purpose of our own—which he calls Reminiscence. This last is like a syllogism or course of ratiocinative inference, performable only by minds capable of taking counsel and calculating. He considers Memory as a movement proceeding from the centre and organs of sense to the soul, and stamping an impression thereupon; while Reminiscence is a counter-movement proceeding from the soul to the organs of sense.‡ In the process of Reminiscence, movements of the soul and movements of the body are conjoined,§ more or less perturbing and durable according to the temperament of the individual. The process is intentional and deliberate, instigated by the desire to search for and recover some lost phantasm or cognition; its success depends upon the fact, that there exists by nature a regular observable order of sequence among the movements of the system, physical as well as psychical. The consequents follow their antecedents either universally, or at least according to customary rules, in the majority of cases.||

The consequent is (1) either like its antecedent, wholly or partially; or (2) contrary to it; or (3) has been actually felt in juxtaposition with it. In reminiscence, we endeavour to regain the forgotten consequent by hunting out some antecedent whereupon it is likely to follow; taking our start either from the present

* Aristot. Analyt. Poster. II. 99, b. 36. *μονὴ τοῦ αἰσθήματος.* It may be remarked that in the Topica, Aristotle urges a dialectic objection against this or a similar doctrine—Topic., IV. 4, 125, b. 6-18—and against his own definition cited in the preceding note, where he calls *μνήμη* an *ἕξις.* Compare the first Chapter of the Metaphysica.

† Aristot. De Memor. et Rem. c. 2, 453, a. 8. He draws the same distinction in Hist. Animal., I. 1, 488, b. 26.

‡ Aristot. De Animâ, I. 4, 408, b. 19; De Memor. et Remin., c. 1, 450, a. 30, 453, a. 9-14. *τὸ ἀναμιμνήσκεσθαί ἐστιν οἷον συλλόγισμός τις.*

§ Aristot. De Memor. et Rem., c. 2, 453, a. 14-23.

|| Aristot. De Memor. et Rem., c. 2, 451, b. 10-17. *συμβαίνουσι δ' αἱ ἀναμνήσεις, ἐπειδὴ πέφυκεν ἡ κίνησις ἥδε γενέσθαι μετὰ τήνδε.*

moment or from some other known point.* We run over many phantasms until we hit upon the true antecedent; the possibility of reminiscence depends upon our having this within our mental reach, among our accessible stock of ideas; if such be not the case, reminiscence is impracticable, and we must learn over again.† We are most likely to succeed, if we get upon the track or order wherein events actually occurred; thus, if we are trying to recollect a forgotten verse or sentence, we begin to repeat it from the first word; the same antecedent may indeed call up different consequents at different times, but it will generally call up what has habitually followed it before.‡

The movements of Memory and of Reminiscence are partly corporeal and partly psychical, just as those of Sensation and Phantasy are. We compare in our remembrance greater and less, (either in time or in external magnitudes) through similar internal movements differing from each other in the same proportion, but all on a miniature scale.§ These internal movements often lead to great discomfort, when a person makes fruitless efforts to recover the forgotten phantasm that he desires; especially with excitable men, who are much disturbed by their own phantasms. They cannot stop the movement once begun; and when their sensitive system is soft and flexible, they find that they have unwittingly provoked the bodily movements belonging to anger or fear, or some other painful emotion.‖ These movements, when once provoked, continue in spite of the opposition of the person that experiences them. He brings upon him-

* Aristot. De Memor. et Rem., c. 2, 451, b. 18. *διὸ καὶ τὸ ἐφεξῆς θηρεύομεν νοήσαντες ἀπὸ τοῦ νῦν ἢ ἄλλου τινός, καὶ ἀφ' ὁμοίου ἢ ἐναντίου ἢ τοῦ συνεγγύς.*

About the associative property of contraries, see again De Somno et Vigil., c. 1, 453, b. 27.

† Aristot. De Memor. et Rem., c. 2, 452, a. 5-12. *πολλάκις δὲ ἤδη μὲν ἀδυνατεῖ ἀναμνησθῆναι, ζητεῖν δὲ δύναται καὶ εὑρίσκει. τοῦτο δὲ γίνεται κινοῦντι πολλὰ, ἕως ἂν τοιάυτην κινήθη κίνησιν, ᾗ ἀκολουθήσει τὸ πρᾶγμα. τὸ γὰρ μεμνῆσθαί ἐστι τὸ ἐνεῖναι δυνάμει την κινοῦσαν· τοῦτο δὲ, ὥστ' εξ αὑτοῦ καὶ ὧν ἔχει κινήσεων κινηθῆναι, ὥσπερ εἴρηται.*

‡ Aristot. De Memor. et Rem., c. 2, 452, a. 2-25.

§ Aristot. De Memor. et Rem., 452, b. 12. *ἔστι γὰρ ἐν αὐτῇ τὰ ὅμοια σχήματα καὶ κινήσεις—πάντα γὰρ τὰ ἐντὸς ἐλάττω, ὥσπερ ἀνάλογον καὶ τὰ ἐκτός.*

‖ Aristot. De Memor. et Rem., 453, a. 22. *ὁ ἀναμιμνησκόμενος, καὶ θηρεύων σωματικόν τι κινεῖ, ἐν ᾧ τὸ πάθος.*

self the reality of the painful emotion; just as we find that after we have very frequently pronounced a sentence or sung a song, the internal movements left in our memories are sometimes so strong and so persistent, that they act on our vocal organs even without any volition on our parts, and determine us to sing the song or pronounce the sentence over again in reality.* Slow men are usually good in Memory, quick men and apt learners are good in Reminiscence: the two are seldom found together.†

In this account of Memory and Reminiscence, Aristotle displays an acute and penetrating intelligence of the great principles of the association of ideas. But these principles are operative not less in Memory than in Reminiscence; and the exaggerated prominence that he has given to the distinction between the two (determined apparently by a wish to keep the procedure of man apart from that of animals) tends to perplex his description of the associative process. At the same time, his manner of characterizing phantasy, memory, and reminiscence, as being all of them at once corporeal and psychical—involving, like sensation, internal movements of the body as well as phases of the consciousness—sometimes even passing into external movements of the bodily organs without our volition; all this is a striking example of psychological observation, as well as of consistency in following out the doctrine laid down at the commencement of the Aristotelian treatise:—Soul as the Form, implicated with Body as the Matter, and the two being an integral concrete separable only by abstraction.

We come now to the highest and (in Aristotle's opinion) most honourable portion of the Soul,—the Nous or noëtic faculty, whereby we cogitate, understand, reason, and believe or opine under the influence of reason.‡ According to the uniform

* Aristot. De Memor. et Rem., 453, a. 23-30. *ἔοικε τὸ πάθος τοῖς ὀνόμασι καὶ μέλεσι καὶ λόγοις, ὅταν διὰ στόματός τι γένηται αὐτῶν σφόδρα· πανσαμένοις γὰρ καὶ οὐ βουλομένοις ἐπέρχεται πάλιν ᾄδειν ἢ λέγειν.*

† Aristot. De Memor. et Rem., 449, a. 7.

‡ Aristot. De Animâ, III. 4, 429, a. 10. *Περὶ δὲ τοῦ μορίου τοῦ τῆς ψυχῆς ᾧ γινώσκει τε ἡ ψυχὴ καὶ φρονεῖ.* He himself defines what he means by *νοῦς* a few lines lower—429, a. 30—and he is careful to specify it as *ὁ τῆς ψυχῆς νοῦς—ὁ ἄρα καλούμενος τῆς ψυχῆς νοῦς (λέγω δὲ νοῦν, ᾧ διανοεῖται καὶ ὑπολαμβάνει ἡ ψυχή).*

In the preceding chapter, he expressly discriminates *νόησις* from scheme of Aristotle, this highest portion of the soul, though distinct from all the lower, presupposes them all. As the sentient Soul presupposes the nutrient, so also the cogitant Soul presupposes the nutrient, the sentient, the phantastic, the memorial, and the reminiscent. Aristotle carefully distinguishes the sentient department of the Soul from the cogitant, and refutes more than once the doctrine of those philosophers that identified the two. But he is equally careful to maintain the correlation between them, and to exhibit the sentient faculty not only as involving in itself a certain measure of intellectual discrimination, but also as an essential and fundamental condition to the agency of the Cogitant, as a portion of the human Soul. We have already gone through the three successive stages—phantastic, memorial, reminiscent—whereby the interval between sensation and cogitation is bridged over. Each of the three is directly dependent on past sensation, either as reproduction or as corollary; each of them is an indispensable condition of man's cogitation; moreover, in the highest of the three, we have actually slid unperceived into the Cogitant phase of the human soul—for Aristotle declares the reminiscent process to be of the nature of a syllogism.* That the Soul cannot cogitate or reason without phantasms—that phantasms are required for the actual working of the human Nous—he affirms in the most explicit manner.†

The doctrine of Aristotle respecting Nous has been a puzzle, even from the time of his first commentators. Partly from the obscurity inherent in the subject, partly from the defective condition of his text as it now stands, his meaning cannot be always clearly comprehended, nor does it seem that the different passages can be completely reconciled.

Anaxagoras, Demokritus, and other philosophers, appear to have spoken of Nous or Intellect in a large and vague sense, as equivalent to Soul generally. Plato seems to have been the first to narrow and specialize the meaning; distinguishing pointedly

ὑπόληψις. This last word *ὑπόληψις* is the most general term for *believing* or *opining*, upon reasons good or bad; the varieties under it are *ἐπιστήμη, δόξα, φρόνησις καὶ τἀνάντια τούτων.*—427, b. 17-25.

* Aristot. De Memor. et Rem., 453, a. 10.

† Aristot. De Memor. et Rem., 449, b. 31, 450, a. 12. *νοεῖν οὐκ ἔστιν ἄνευ φαντάσματος—ἡ δὲ μνήμη καὶ ἡ τῶν νοητῶν οὐκ ἄνευ φαντάσματός ἐστιν.*—De Animâ, III. 7, 431, a. 16.

(as we have stated above) the rational or encephalic soul, in the cranium, with its circular rotations, from the two lower souls, thoracic and abdominal. Aristotle agreed with him in this distinction (either of separate souls or of separate functions in the same soul); but he attenuated and divested it of all connexion with separate corporeal lodgment, or with peculiar movements of any kind. In his psychology, the brain no longer appears as the seat of intelligence, but simply as a cold, moist, and senseless organ, destined to countervail the excessive heat of the heart; which last is the great centre of animal heat, of life, and of the sentient soul. Aristotle declares Nous not to be connected with, or dependent on, any given bodily organs or movements appropriated to itself; this is one main circumstance distinguishing it from the nutrient Soul as well as from the sentient Soul, each of which rests indispensably upon corporeal organs and agencies of its own.

It will be remembered that we stated the relation of Soul to Body (in Aristotle's view) as that of Form to Matter; the two together constituting a concrete individual, numerically One; also that Form and Matter, each being essentially relative to the other, admitted of gradations, higher and lower; *e.g.* a massive cube of marble is already Materia Formata, but it is still purely Materia, relative to the statue that may be obtained from it. Now, the grand region of Form is the CELESTIAL BODY—the vast, deep, perceivable, circular mass circumscribing the Kosmos, and enclosing, in and around its centre, Earth with the other three elements, tenanted by substances generated and perishable. This Celestial Body is the abode of divinity, including many divine Beings who take part in its eternal rotations—viz., the Sun, Moon, Stars, &c.,—and other Gods. Now, every Soul, or every Form that animates the Matter of a living being, derives its vitalizing influence from this celestial region. All seeds of life include within them a spiritual or gaseous heat, more divine than the four elements, proceeding from the Sun, and in nature akin to the element of the stars. Such solar or celestial heat differs generically from the heat of fire. It is the only source from whence the principle of life, with the animal heat that accompanies it, can be obtained. Soul, in all its varieties, proceeds from hence.*

* Aristot. De Generat. Animal., II. 3, 736, b. 29. *πάσης μὲν οὖν ψυχῆς δυναμις ἑτέρου σώματος ἔοικε κεκοινωνηκέναι καὶ θειοτέρου τῶν καλου-*

But though all varieties of Soul emanate from the same celestial source, they possess the divine element in very different degrees, and are very unequal in comparative worth and dignity. The lowest variety, or nutritive Soul—the only one possessed by plants, among which there is no separation of sex (in Aristotle's view*)—is contained potentially in the seed, and is thus transmitted when that seed is matured into a new individual. In animals, who possess it along with the sensitive soul and among whom the sexes are separated, it is also contained potentially in the generative system of the female separately; and the first commencement of life in the future animal is thus a purely vegetable life.† The sensitive soul, the characteristic of the complete animal, cannot be superadded except by copulation and the male semen. The female being comparatively impotent and having less animal heat, furnishes only the *Matter* of the future offspring; *Form*, or the moving, fecundating, cause, is supplied by the male. Through the two together, the new individual animal is completed, having not merely the nutritive Soul, but also the sentient Soul along with it.‡

Both the nutritive and the sentient Soul have, each of them respectively, a special bodily agency and movement belonging to them. But the Nous, or the Noëtic Soul, has no partnership with any similar bodily agency. There is no special corporeal potentiality (to speak in Aristotelian language) which it is destined to actualize. It enters from without, and emanates from a still more exalted influence of that divine celestial substance from which all psychical or vitalizing heat proceeds.§ It is

μένων στοιχείων· ὡς δὲ διαφέρουσι τιμιότητι αἱ ψυχαὶ καὶ ἀτιμίᾳ ἀλλήλων, οὕτω καὶ ἡ τοιάυτη διαφέρει φύσις· πάντων μὲν γὰρ ἐν τῷ σπέρματι ἐνυπάρχει, ὅπερ ποιεῖ γόνιμα εἶναι τὰ σπέρματα, τὸ καλούμενον θερμόν.

* Aristot. De Generat. Animal., I. 23, 731, a. 27.

† Aristot. De Generat. Animal., II. 3, 736, a. 22, b. 4-12.

‡ Aristot. De Generat. Animal., I. 2, 716, a. 5-17, 726, b. 33, 728, a. 17, 729, b. 6-27.

§ Aristot. De Generat. Animal., II. 3, 736, b. 28. *λείπεται δὲ τὸν νοῦν μόνον θύραθεν ἐπεισιέναι, καὶ θεῖον εἶναι μόνον· οὐθὲν γὰρ αὐτοῦ τῇ ἐνεργείᾳ κοινωνεῖ σωματικὴ ἐνέργεια.* The words *θεῖον εἶναι μόνον* must not be construed strictly; for in the next following passage, he proceeds to declare that *all* ψυχὴ-ψυχικὴ δύναμις or ἀρχὴ partakes of the divine element, and that in this respect there is only a difference of degree between one ψυχὴ and another.

superinduced upon the nutritive and sentient Souls, and introduces itself at an age of the individual later than both of them. Having no part of the bodily organism specially appropriated to it, this variety of Soul—what is called the Nous—stands distinguished from the other two in being perfectly separable from the body;* that is, separable from the organized body which it is the essential function of the two lower souls to actualize, and with which both of them are bound up. The Nous is not separable from body altogether; it belongs essentially to the divine celestial body, and to those luminaries and other divine Beings by whom portions of it are tenanted. Theorizing contemplation—the perfect, unclouded, unembarrassed, exercise of the theoretical Nous—is the single mental activity of these divinities; contemplation of the formal regularity of the Kosmos, with its eternal and faultless rotations, and with their own perfection as participating therein. The celestial body is the body whereto Nous, or the noëtic Soul, properly belongs;† quite apart from the two other Souls, sentient and nutritive, upon which it is grafted in the animal body; and apart also from all the necessities of human action, preceded by balanced motives and deliberate choice.‡

From this celestial body, a certain influence of Nous is transferred to some of the mortal inhabitants of earth, water, and air. Thus a third or noëtic Soul—or rather a third noëtic function—is added to the two existing functions, sensitive and nutrient, of the animal Soul, which acquires thereby an improved aptitude for, and correlation with, the Formal and Universal. We have already stated that the sensitive Soul possesses this aptitude to a certain extent; it receives the impression of sensible Forms, without being impressed by the Matter accompanying them. The noëtic function strengthens and sharpens the aptitude; the Soul comes into correlation with those cogitable or intellective Forms

* Aristot. De Generat. Animal., II. 3, 737, a. 10. *ὁ καλούμενος νοῦς.*—De Animâ, II. 2, 413, b. 25; II. 3, 415, a. 11.

† Respecting *τὸ ἄνω σῶμα*, see the copious citations in Trendelenburg's note ad Aristot. De Animâ, II., 7, 2, p. 373.

‡ Aristot. Ethic. Nikom., X. 8, 1178, b. 20. *τῷ δὴ ζῶντι, τοῦ πράττειν ἀφῃρημένῳ, ἔτι δὲ μᾶλλον τοῦ ποιεῖν, τί λείπεται πλὴν θεωρίας; ὥστε ἡ τοῦ θεοῦ ἐνέργεια, μακαριότητι διαφέρουσα, θεωρητικὴ ἂν εἴη.*—See also Metaphysic Λ. 5, 1074, b. 26-35.

which are involved in the sensible Forms;* it rises from the lower generalities of the Second Philosophy, to the higher generalities of the First Philosophy.

As the sentient or percipient Soul is the Form or Correlate of all perceivables, and thus identified with them in nature, all of them having existence only in relation to it—so the cogitant or intellective Soul is the Form or Correlate of all Cogitabilia, all of which exist relatively to it, and only relatively.† It is in fact the highest of all Forms—the Form of Forms; the mental or subjective aspect of all formal reality.

Such at least is the tendency and purpose of that noëtic influence which the celestial substance imparts to the human Soul; but it is realized only to a very small degree. In its characteristic theorizing efficacy, the godlike Nous counts for a small fraction of the whole soul, though superexcellent in quality.‡ There are but few men in whom it is tolerably developed, and even in those few, it is countervailed by many other agencies.§ The noëtic function in men and animals exists only in companionship with the two other psychical functions. It is subservient to the limits and conditions that they impose, as well as to the necessities of individual and social action; to all that is required for "acting like a man," according to the Aristotelian phrase. Man's nature is complex, and not self-sufficing for a life of theorizing contemplation, such as that wherein the celestial inmates pass their immortality of happiness.||

We have thus to study the noëtic function, according to the manifestations of it that we find in man, and to a certain extent in some other privileged animals. Bees, for example, partake in

* Aristot. De Animâ, III. 8, 432, a. 6. ἐν τοῖς εἴδεσι τοῖς αἰσθητοῖς τὰ νοητά ἐστιν.

† Aristot. De Animâ, III. 8, 431, a. 22, 432, b. 10. ὁ νοῦς εἶδος εἰδῶν καὶ ἡ αἴσθησις εἶδος αἰσθητῶν.

‡ Aristot. Ethic. Nikom., X. 7, 1178, a. 1. εἰ γὰρ καὶ τῷ ὄγκῳ μικρόν ἐστι, δυνάμει καὶ τιμιότητι πολὺ μᾶλλον πάντων ὑπερέχει.

§ Aristot. De Memor. et Remin., c. 1, 450, a. 18.

|| Aristot. Ethic. Nikom., X. 7-8-9, 1177, b. 24, 1178, a. 22, b. 6-34. δεήσεται οὖν τοιούτων πρὸς τὸ ἀνθρωπένεσθαι—οὐκ αὐτάρκης ἡ φύσις πρὸς τὸ θεωρεῖν—ὁ δὲ τοιοῦτος ἂν εἴη βίος κρείττων ἢ κατ' ἄνθρωπον. Compare similar sentiments in Aristot. Metaphys., A. 983, a. 1.

the divine gift to a certain extent; being distinguished in this respect from their analoga—wasps and hornets.*

In these and other animals, and in man to a still greater degree, the theorizing activity exists; but it is either starved, or at least has to deal with materials obscure, puzzling, conflicting; while, on the other hand, the practical intellect becomes largely developed, through the pressure of wants and desires, combined with the teaching of experience. In Aristotle's view, sensible perception is a separate source of knowledge, accompanied with judgment and discrimination, independent of the noëtic function. Occasionally, he refers the intellectual superiority of man to the properly attempered combination and antagonism of heat in the heart with cold in the brain, each strong and pure;† all the highly endowed animals (he says) have greater animal heat, which is the essential condition of a better soul;‡ he reckons the finer sense of touch possessed by man as an essential condition of the same intel-

* Aristot. De Generat. Animal., III. 760, a. 5, 761, a. 5. *ὄντος δὲ περιττοῦ τοῦ γένους καὶ ἰδίου τοῦ τῶν μελιττῶν—οὐ γὰρ ἔχουσιν* (wasps and hornets) *οὐδὲν θεῖον, ὥσπερ το γένος τῶν μελιττῶν*. It is remarkable that *περιττὸς*, the epithet here applied by Aristotle to bees, is the epithet that he also applies to men of theoretical and speculative activity, as contrasted with men prudent and judicious in action.—See Metaphys., I. 983, a. 2, also, Ethic. Nikom., VI. 7, 1141, b. 6. Elsewhere he calls bees *φρόνιμα*—Metaphys., I. 1, 980, b. 22. See a good note of Torstrick on Aristot. De Animâ, III. 428, a. 10, p. 172 of his Commentary. Aristotle may possibly have been one among the philosophers that Virgil had in his mind, Georgics, IV. 220,

"His quidam signis, atque hæc exempla secuti
Esse apibus partem divinæ mentis, et haustus
Ætherios dixere: Deum namque ire per omnes
Terrasque tractusque maris, cælumque profundum," &c.

† Aristot. De Generat. Animal., II. 6, 744, a. 11-30. *δηλοῖ δὲ τὴν εὐκρασίαν ἡ διάνοια· φρονιμώτατον γάρ ἐστι τῶν ζῴων ἄνθρωπος.* We may remark that Aristotle considers cold as, in some cases, a positive property; not simply as the absence or privation of heat (De Partibus Animal., II. 649, a. 18). The heart is the part wherein the psychical fire (as it were) is kept burning—*τῆς ψυχῆς ὥσπερ ἐμπεπυρευμένης ἐν τούτοις τοῖς τόποις*—Aristot. De Vitâ et Morte, c. 4, 469, b. 16. Virgil, in the beautiful lines of his second Georgic (483), laments that he is disqualified for deep philosophical studies by the want of heat round his heart.

"Sin, has ne possim naturæ accedere partes,
Frigidus obstiterit circum præcordia sanguis," &c.

‡ Aristot. De Respirat., c. 13, 477, a. 16.

lectual result.* Sensible perception in its five diverse manifestations, together with its secondary psychical effects—phantasy and memory, accumulate in the human mind (and in some animals) a greater or less experience of particular facts; from some of which, inferences are drawn as to others unknown, directing conduct as well as enlarging knowledge.†

All this process, a perpetual movement of sense and memory, begins from infancy, and goes on independently of Nous or the noëtic function properly so called; which grows up gradually at a later age, aided by the acquisition of language and by instruction conveyed through language. The supervening Nous presupposes and depends upon what has been thus treasured up by experience. Though, in the celestial body, Nous exists separately from human beings, and though it there operates *proprio motu* apart from sense—such is not the case with the human Nous; which depends upon the co-operation, and is subject to the restrictions, of the complicated Soul and Body wherewith it is domiciled; restrictions differing in each individual case. Though the noëtic process is distinct from sense, yet without sense it cannot take place in man. Aristotle expressly says—"You cannot cogitate without a phantasm or without a continuous image." Now, the phantasm has been already explained as a relic of movements of sense,—or as those movements themselves, looked at in another point of view.‡ "When we cogitate" (he says) "our mental affection is the same as when we draw a triangle for geometrical study; for there, though we do not make use of the fact that the triangle is determinate in its magnitude, we still draw it of a determinate magnitude. So in cogitation, even when we are not cogitating a determinate quantum, we nevertheless set before our eyes a (determinate) quantum, but we do not cogitate it *quâtenus* determinate."§ We cannot even remember (he goes on to say) the Cogitabilia

* Aristot. De Animâ, II. 9, 421, a. 23.

† Aristot. Metaphys., A., c. 1.

‡ Aristot. De Somniis, c. 1, 459, a. 15; De Animâ, III. 7, 431, a. 17, 428, b. 12.

§ Aristot. De Memor. et Remin., c. 1, 449, b. 13. *ἐπεὶ δὲ περὶ φαντασίας εἴρηται ἐν τοῖς περὶ ψυχῆς, καὶ νοεῖν οὐκ ἔστιν ἄνευ φαντάσματος· συμβαίνει γὰρ τὸ αὐτὸ πάθος ἐν τῷ νοεῖν ὅπερ καὶ ἐν τῷ διαγράφειν· ἐκεῖ τε γαρ οὐθὲν προσχρώμενοι τῷ τὸ ποσὸν ὡρισμένον εἶναι τοῦ τριγώνου, ὅμως γράφομεν ὡρισμένον κατὰ τὸ ποσόν· καὶ ὁ νοῶν* without "a phantasm or sensible image; so that our memory of them is only by way of concomitance" (indirect and secondary).* Phantasy is thus absolutely indispensable to cogitation: first to carrying on the process at all; next to remembering it after it is past. Without either the visible phantasm of objects seen and touched, or the audible phantasm of words heard and remembered, the Nous in human beings would be a nullity.†

We see that though Aristotle recognizes a general distinction between phantasy and cogitation, and alludes to many animals as having the former without attaining to the latter, yet he also declares that in man, who possesses both, not only is cogitation dependent upon phantasy, but phantasy passes into cogitation by gradations almost imperceptible. In regard to the practical application of Nous (*i.e.*, to animal movements determined either by appetite or by reason), he finds a great difficulty in keeping up the distinction clearly marked. Substantially indeed he lets it drop. When he speaks of phantasy as being either calculating or perceptive, we are unable to see in what respect *calculating phantasy* (which he states not to belong to other animals) differs from an effort of cogitation.‡ Indeed, he speaks with some diffidence respecting any distribution of parts in the same Soul;

ὡσαύτως, κἂν μὴ ποσὸν νοῇ, τίθεται πρὸ ὀμμάτων ποσόν, νοεῖ δ' οὐχ ᾗ ποσόν.

See De Sensu et Sensili, c. 6, 445, b. 17; De Animâ, III. 8, 432, a. 9. The above passage, extracted from the treatise De Memoriâ et Rem., appears to be as clear a statement of the main doctrine of Nominalism as can be found in Hobbes or Berkeley. In the sixteenth section of the Introduction to the Principles of Human Knowledge, Berkeley says—"And here it must be acknowledged that a man may consider a figure merely as triangular, without attending to the particular qualities of the angles or relations of the sides. In like manner we may consider Peter so far forth as man, or so far forth as animal, without framing the forementioned idea, either of man or animal, *inasmuch as all that is perceived is not considered.*"—Berkeley has not improved upon the statement of Aristotle.

* Aristot. De Memor. et Remin., c. 1, 450, a. 13.

† About sense and hearing, as the fundamenta of intellect, see Aristot. de Sensu et Sensili, c. 1, 437, a. 1-17.

‡ Aristot. De Animâ, III. 10, 433, a. 10, b. 12-29. εἴ τις τὴν φαντασίαν τιθείη ὡς νόησίν τινα—φαντασία δὲ πᾶσα ἢ λογιστικὴ ἢ αἰσθητική· ταύτης μὲν οὖν καὶ τὰ ἄλλα ζῷα μετέχει.—Also, III. 7, 431, b. 7.

suspecting that such distribution is not real but logical; you may subdivide as much as you choose.*

It appears thus clear that Aristotle restricts the Nous or noëtic function *in man* to the matters of sense and experience, physical or mental, and that he considers the phantasm to be an essential accompaniment of the cogitative act. Yet this does not at all detract from his view of the grandeur, importance, and wide range of survey, belonging to the noëtic function. It is the portion of man's nature that correlates with the abstract and universal; but it is only a portion of his nature, and must work in conjunction and harmony with the rest. The abstract cannot be really separated from the concrete, nor the universal from one or other of its particulars, nor the essence from that whereof it is the essence, nor the attribute from that of which it is the attribute, nor the genus and species from the individuals comprehended therein; nor, to speak in purely Aristotelian language, the Form from some Matter, or the Matter from some Form. In all these cases, there is a *notional* or *logical* distinction, impressing the mind as the result of various comparisons, noted by an appropriate term, and remembered afterwards by means of that term (that is, by means of an audible or visible phantasm); but real separation there neither is nor can be. This is the cardinal principle of Aristotle, repeated in almost all his works; his marked antithesis against Plato. Such logical distinctions as those here noticed (they might be multiplied without number) it belongs to Nous or the noëtic function to cognize. But the real objects, in reference to which alone the distinctions have a meaning, are concrete and individual; and the cognizing Subject is really the entire man, employing indeed the noëtic function, but employing it with the aid of other mental forces, phantasms and remembrances, real and verbal.

The noëtic Soul is called by Aristotle 'the place of Forms, the potentiality of Forms; the Correlate of things apart from Matter.' † It cogitates these Forms in or along with the phantasms; the cogitable Forms are contained *in* the sensible Forms; for there is nothing really existent beyond or apart from visible or tangible magnitudes, with their properties and affections,

* Aristot. De Animâ, III. 9, 432, a. 23.

† Aristot. De Animâ, III. 4, 429, a. 27, b. 22.

and with the so-called abstractions considered by the geometer. Hence, without sensible perception, a man can neither learn nor understand any thing; in all his theoretical contemplations, he requires some phantasm to contemplate along with them.*

Herein lies one of the main distinctions between the noëtic and the sentient souls. The sentient deals with particulars, and correlates with external bodies; the noëtic apprehends universals, which in a certain sense are within the soul: hence a man can cogitate whenever or whatever he chooses, but he can see or touch only what is present.† Another distinction is, that the sentient soul is embodied in special organs, each with determinate capacities, and correlating with external objects, themselves alike determinate, acting only under certain conditions of locality. The possibilities of sensation are thus from the beginning limited; moreover, a certain relative proportion must be maintained between the Percipient and the Perceivable; for extreme or violent sounds, colours, &c., produce no sensation; on the contrary, they deaden the sentient organ.‡ But the noëtic soul (what is called the Nous of the Soul, to use Aristotle's language) § is nothing at all in actuality before its noëtic function commences, though it is everything in potentiality. It is not embodied in any corporeal organ of its own, nor mingled as a new elementary ingredient with the body; it does not correlate with any external objects; it is not so specially attached to some particulars as to make it antipathetic to others. Accordingly its possibilities of cogitation are unlimited; it apprehends with equal facility what is most cogitable and what is least cogitable. It is thoroughly indeterminate in its nature, and is in fact at first a mere unlimited

* Aristot. De Animâ, III. 7, 431, b. 1. *τὰ μὲν οὖν εἴδη τὸ νοητικὸν ἐν τοῖς φαντάσμασι νοεῖ.*—432, a. 3. *ἐπεὶ δὲ οὐδὲ πρᾶγμα οὐθέν ἐστι παρὰ τὰ μεγέθη, ὡς δοκεῖ, τὰ αἰσθητὰ κεχωρισμένον, ἐν τοῖς εἴδεσι τοῖς αἰσθητοῖς τὰ νοητά ἐστιν, τά τε ἐν ἀφαιρέσει λεγόμενα, καὶ ὅσα τῶν αἰσθητῶν ἕξεις καὶ πάθη· καὶ διὰ τοῦτο οὔτε μὴ αἰσθανόμενος μηδὲν οὐθὲν ἂν μάθοι οὐδὲ ξυνείη· ὅταν δὲ θεωρῇ, ἀνάγκη ἅμα φάντασμά τι θεωρεῖν.*

† Aristot. De Animâ, II. 5, 417, b. 22.

‡ Aristot. De Animâ, III. 4, 429, a. 29.

§ Aristot. De Animâ, III. 4, 429, a. 22. *ὁ ἄρα καλούμενος τῆς ψυχῆς νοῦς (λέγω δε νοῦν ᾧ διανοεῖται καὶ ὑπολαμβάνει ἡ ψυχή) οὐθέν εστιν ἐνεργείᾳ πρὶν νοεῖν.*

cogitative potentiality;* like a tablet, upon which no letters have as yet been written, but upon which all or any letters *may be* written.†

We have already said that the Nous of the human soul emanates from a peculiar influence of the celestial body, which is the especial region of Form in the Kosmos. Through it we acquire an enlarged power of apprehending the abstract and universal; we can ascend above sensible forms to the cogitable forms contained therein; we can consider all forms in themselves, without paying attention to the matter wherein they are embodied. Instead of considering the concrete solid or liquid before us, we can mentally analyze them, and thus study solidity in the abstract, fluidity in the abstract. While our senses judge of water as hot and cold, our noëtic function enables us to appreciate water in the abstract; to determine its essence, and to furnish a definition of it.‡ In all these objects, as combinations of Form with Matter, the cogitable form exists potentially; and is abstracted, or considered abstractedly, by the cogitant Nous.§ Yet this last cannot operate except along with and by aid of phantasms (as we have already seen)—of impressions revived or remaining from sense. It is thus immersed in the materials of sense, and has no others. But it handles them in a way of its own, and under new points of view; comparing and analyzing; recognizing the abstract in the concrete, and the universal in the particular; discriminating mentally and logically the one from the other; and noting the distinction by appropriate terms. Such distinctions are the Noumena, generated in the process of cogitation by Nous itself. The Nous, as it exists in any individual, gradually loses its original character of naked potentiality, and becomes an actual working force, by means of its own acquired materials.‖ It is an aggregate of Noumena, all of them in nature identical with itself; and while cogitating them, the Nous at the same time cogitates itself. Considered abstractedly, apart

* Aristot. De Animâ, III. 4, 429, a. 21. *ὥστε μηδ' αὐτοῦ εἶναι φύσιν μηδεμίαν ἀλλ' ἢ ταύτην, ὅτι δυνατόν.*

† Aristot. De Animâ, III. 4, 430, a. 1.

‡ Aristot. De Animâ, III. 4, 429, b. 10.

§ Aristot. De Animâ, III. 4, 430, a. 2-12.

‖ Aristot. De Animâ, II. 5, 417, b. 23; III. 4, 429, b. 7. *ὅταν δύνηται ἐνεργεῖν δι' αυτοῦ.*

from matter, they exist only in the mind itself; in theoretical speculation, the Cognoscens and the Cognitum are identical. But they are not really separable from matter, and have no reality apart from it.*

The distinction, yet at the same time correlation, between Form and Matter, pervades all nature (Aristotle affirms), and will be found in the Nous as elsewhere. We must recognize an Intellectus Agens or constructive—and an Intellectus Patiens or receptive.† The Agens is the great intellectual energy pervading the celestial body, and acting upon all the animals susceptible of its operation; analogous to light, which illuminates the diaphanous medium, and elevates what was mere potential colour into colour actual and visible.‡ The Patiens is the intellectual receptivity acted upon in each individual, and capable of being made to cogitate every thing; anterior to the Agens, in time, so far as regards the individual—yet as a general fact (when we are talking of man as a species), not anterior even in time, but correlative. Of the two, the Intellectus Agens is the more venerable; it is pure intellectual energy, unmixed, unimpressible from without, and separable from all animal body. It is this, and nothing more, when considered apart from animal body; but it is then eternal and immortal, while the Intellectus Patiens perishes with the remaining soul and with the body. Yet though the Intellectus Agens is thus eternal, and though *we* have part in it, we cannot remember any of its operations anterior to our own maturity; for the concurrence of the Intellectus Patiens, which

* Aristot. De Animâ, III. 4, 429, b. 9, 430, a. 2-7.

† Aristot. De Animâ, III. 5, 430, a. 11.

‡ Aristot. De Animâ, III. 5, 430, a. 15. *καὶ ἔστιν ὁ μὲν τοιοῦτος νοῦς τῷ πάντα γίνεσθαι, ὁ δὲ τῷ πάντα ποιεῖν, ὡς ἕξις τις, οἷον τὸ φῶς· τρόπον γάρ τινα καὶ τὸ φῶς ποιεῖ τὰ δυνάμει ὄντα χρώματα ἐνεργείᾳ χρώματα.* Aristotle here illustrates *νοῦς ποιητικὸς* by *φῶς* and *ἕξις*; and we know what view he takes of *φῶς* (De Animâ, II. 7, 418, b. 9), as the *ἐνέργεια* or *ἕξις τοῦ διαφανοῦς*—which *diaphanous* he explains to be a *φύσις τις ἐνυπάρχουσα ἐν ἀέρι καὶ ὕδατι καὶ ἐν τῷ ἀϊδίῳ τῷ ἄνω σώματι.* Judging by this illustration, it seems proper to couple the *νοῦς ποιητικὸς* here with his declaration in De Generat. Animal., II. 736, b. 28, 737, a. 10. *τὸν νοῦν μόνον θύραθεν ἐπεισιέναι καὶ θεῖον εἶναι μόνον*: he cannot consider the *νοῦς ποιητικὸς* which is of the nature of Form, as belonging to each individual man, like the *νοῦς παθητικός*.

begins and ends with us, is indispensable both to remembrance and to thought.*

We see here the full extent of Aristotle's difference from the Platonic doctrine, in respect to the immortality of the Soul. He had defined the Soul as the first actualization of a body having potentiality of life with a determinate organism. This of course implied, and he expressly declares it, that Soul and Body in each individual case were one and indivisible, so that the soul of Sokrates perished of necessity with the body of Sokrates.† But he accompanied that declaration with a reserve in favour of Nous, and especially of the theorizing Nous; which he recognized as a different sort of Soul, not dependent on a determinate bodily organism, but capable of being separated from it, as the eternal is from the perishable.‡ The present chapter informs us how far such reserve is intended to go. That the theorizing Nous is not limited, like the sentient soul, to a determinate bodily organism, but exists apart from that organism and eternally—is maintained as incontestable; it is the characteristic intellectual activity of the eternal celestial body and the divine inmates thereof. But the distinction of Form and Matter is here pointed out, as prevailing in Nous and in Soul generally, not less than throughout all other Nature. The theorizing Nous, as it exists in Sokrates, Plato, Demokritus, Anaxagoras, Empedokles, Xenokrates, &c., is individualized in each, and individualized differently in each. It represents the result of the Intellectus Agens or formal Nous, universal and permanent, upon the Intellectus Patiens or noëtic receptivity peculiar to each individual; the co-operation of the two is indispensable, to sustain the theorizing Intellect of any in-

* Aristot. De Animâ, III. 5, 430, a. 18. *καὶ οὗτος ὁ νοῦς* (*i.e.* *ποιητικός*) *χωριστὸς καὶ ἀπαθὴς καὶ ἀμιγής, τῇ οὐσίᾳ ὢν ἐνέργεια· ἀεὶ γὰρ τιμιώτερον τὸ ποιοῦν τοῦ πάσχοντος, καὶ ἡ ἀρχὴ τῆς ὕλης*—a. 22. *χωρισθεὶς δ' ἔστι μόνον τοῦθ' ὅπερ ἔστι, καὶ τοῦτο μόνον ἀθάνατον καὶ ἀΐδιον· οὐ μνημονεύομεν δὲ, ὅτι τοῦτο μὲν ἀπαθὲς, ὁ δὲ παθητικὸς νοῦς φθαρτὸς, καὶ ἄνευ τούτου οὐθὲν νοεῖ.* In this obscure and difficult chapter (difficult even to Theophrastus the friend and pupil of the author), we have given the best meaning that the words seem to admit.

† Aristot. De Animâ, II. 1, 413, a. 3, b. 7.

‡ Aristot. De Animâ, II. 2, 413, b. 25. *περὶ δὲ τοῦ νοῦ καὶ τῆς θεωρητικῆς δυνάμεως οὐδέν πω φανερὸν, ἀλλ' ἔοικε ψυχῆς γένος ἕτερον εἶναι, καὶ τοῦτο μόνον ἐνδέχεται χωρίζεσθαι, ὥσπερ τὸ ἀΐδιον τοῦ φθαρτοῦ.*

dividual man. But the Intellectus Patiens, or Receptivus, perishes along with the individual. Accordingly, the intellectual life of Sokrates cannot be continued farther. It cannot be prolonged after his sensitive and nutritive life has ceased; the noëtic function, as it exists in him, is subject to the same limits of duration as the other functions of the Soul. The intellectual man is no more immortal than the sentient man.

Such is the opinion here delivered by Aristotle. And it follows indeed as a distinct corollary from his doctrine respecting animal and vegetable procreation in general. Individuality (the being Unum Numero in a species) and immortality are in his view incompatible facts; the one excludes the other. In assigning (as he so often does) a final cause or purpose to the wide-spread fact of procreation of species by animals and vegetables, he tells us, that every individual living organism, having once attained the advantage of existence, yearns and aspires to prolong this for ever, and to become immortal. But this aspiration cannot be realized; Nature has forbidden it, or is inadequate to it; no individual can be immortal. Being precluded from separate immortality, the individual approaches as near to it as is possible, by generating a new individual like itself, and thus perpetuating the species. Such is the explanation given by Aristotle of the great fact pervading the sublunary, organized world;* immortal species of plants, animals, and men—through a succession of individuals each essentially perishable. The general doctrine applies to Nous as well as to the other functions of the Soul. Nous is immortal; but the individual Sokrates, considered as noëtic or intellectual, can no more be immortal than the same individual considered as sentient or reminiscent.

We have already stated that Nous—Intellect—the noëtic function—is that faculty of the Soul that correlates with the abstract and universal; with Form apart from Matter. Its process is at once analytical, synthetical, and retentive. Nature presents to us only concretes and particulars, in a perpetual course of change and reciprocal action; in these the abstract and universal are immersed, and out of these they have to be disengaged by logical analysis. That the abstract is a derivative from

* Aristot. De Generat. Animal., II. 1, 731, b. 21, seq.; De Animâ, II. 4, 415, a. 26, seq.; Economica, I. 3, 1343, b. 23.

the concrete, and the universal from particulars—is the doctrine of Aristotle. Ascending from particulars, the analysis is carried so far that at length it can go no farther. It continues to divide until it comes to *indivisibles*, or simple notions, the highest abstractions, and the largest universals. These are the elements out of which universal propositions are formed, the first premisses or principia of demonstration. Unphilosophical minds do not reach these *indivisibles* at all: but it is the function of the theorizing Nous to fasten on them, and combine them into true propositions. In so far as regards the indivisibles themselves, falsehood is out of the question, and truth also, since they affirm nothing. The mind either apprehends them, or it does not apprehend them; there is no other alternative.* But when combined into affirmative propositions, they then are true or false, as the case may be. The formal essence of each object is among these indivisibles, and is apprehended as such by the intellect; which, while confining itself to such essence, is unerring, as each sense is in regard to its own appropriate perceivables.† But when the intellect goes farther, and proceeds to predicate any attribute respecting the essence, then it becomes liable to error, as sense is when drawing inferences.

One of the chief functions that Aristotle assigns to Nous, or the noëtic function, is that the *principia* of demonstration and knowledge belong to it; and not merely the *principia*, but also, in cases of action preceded by deliberation and balance of motives, the ultimate application of *principia* to action. So that he styles Nous both beginning and end; also the beginning of the beginning; and moreover he declares it to be always right and unerring—equal to Science and even more than Science.‡ These are high praises, conveying little information, and not reconcilable with other passages wherein he speaks of the *exercise* of the noëtic function (*τὸ νοεῖν*) as sometimes right, sometimes

* Aristot. De Animâ, III. 6, 430, a. 26. *ἡ μὲν οὖν τῶν ἀδιαιρέτων νόησις ἐν τούτοις περὶ ἃ οὐκ ἔστι τὸ ψεῦδος· ἐν οἷς δὲ καὶ τὸ ψεῦδος καὶ τὸ ἀληθὲς, σύνθεσίς τις ἤδη νοημάτων ὥσπερ ἓν ὄντων.*—Metaphysica, Θ. 10, 1051, b. 31. *περὶ ταῦτα οὐκ ἔστιν ἀπατηθῆναι, ἀλλ' ἢ νοεῖν ἢ μή.*

† Aristot. De Animâ, III. 6, 430, b. 29. This portion of the treatise is peculiarly confused and difficult to understand.

‡ Aristot. Ethic. Nikomach., VI. 12, 1143, a. 23, b. 10. *διὸ καὶ ἀρχὴ καὶ τέλος νοῦς.*—Analyt. Post., II. 18, 100, b. 5.

wrong.* But for the question of psychology, the point to be determined is, in what sense he meant that *principia* belonged to Nous. He certainly did not mean that the first principles of reasoning were novelties originated, suggested, or introduced into the soul by noëtic influence. Not only he does not say this, but he takes pains to impress the exact contrary. In passages cited a few pages back, he declares that Nous in entering the Soul brings nothing whatever with it; that it is an universal potentiality—a capacity in regard to truth, but nothing more ;† that it is in fact a capacity not merely for comparing and judging (to both of which he recognizes even the sentient soul as competent), but also for combining many into one, and resolving the apparent one into several; for abstracting, generalizing, and selecting among the phantasms present, which of them should be attended to, and which should be left out of attention.‡ Such is his opinion about the noëtic function ; and he states explicitly that the abstract and universal not only arise from the concrete and particular, but are inseparable from the same really—separable only logically.

He describes, at the end of the Analytica Posteriora and elsewhere, the steps whereby the mind ascends gradually from sense, memory, and experience, to general principles. And he indicates a curious contrast between these and the noëtic functions. Sense, memory, phantasy, reminiscence, are movements of the body as well as of the soul; our thoughts and feelings come and go, none of them remaining long. But the noëtic process is the reverse of this ; it is an arrest of all this mental movement, a detention of the fugitive thoughts, a subsidence from perturbation—so that the attention dwells steadily and for some time on the same matters.§ Analysis, selection, and con-

* Aristot. De Animâ, III. 3, 427, b. 9. *ἀλλ' ουδὲ τὸ νοεῖν, ἐν ᾧ ἔστι τὸ ὀρθῶς· καὶ μὴ ὀρθῶς διανοεῖσθαι δ' ἐνδέχεται καὶ ψευδῶς.*

† Aristot. De Animâ, I. 2, 403, b. 30—where he censures Demokritus. *οὐ δὴ χρῆται τῷ νῷ ὡς δυνάμει τινὶ περὶ τὴν αληθειαν, αλλὰ ταὐτὸ λέγει ψυχὴν καὶ νοῦν.* Compare De Animâ, III. 4, 429, a. 21, b. 30.

‡ Aristot. De Animâ, III. 6, 430, b. 5. *τὸ δὲ ἓν ποιοῦν, τοῦτο ὁ νοῦς ἕκαστον.*—III. 11, 434, a. 10.

§ Aristot. Physica, VII. 3, 247, b. 9. *ἡ δ' ἐξ ἀρχῆς λῆψις ἐπιστήμης γένεσις οὐκ ἔστιν· τῷ γὰρ ἠρεμῆσαι καὶ στῆναι τὴν διάνοιαν ἐπίστασθαι καὶ φρονεῖν λέγομεν.*—Also, De Animâ, I. 3, 406, b. 32, and the remarkable passage in the Analytica Poster., II. 18, 100, a. 3, b. 5.

centration of attention, are the real characteristics of the Aristotelian Nous. It is not (as some philosophers have thought) a source of new general truths, let into the soul by a separate door, and independent of experience as well as transcending experience.

Passing now to the Emotions, we find that these are not systematically classified and analyzed by Aristotle, as belonging to a scheme of Psychology; though he treats them incidentally, with great ability and acuteness, both in his Ethics, where he regards them as auxiliaries or impediments to a rational plan of life, and in his Rhetoric, where he touches upon their operation as it bears on oratorical effect. He introduces however in his Psychology some answer to the question, What is it that produces local movement in the animal body? He replies that movement is produced both by Nous and by Appetite.

Speaking strictly, we ought to call Appetite alone the direct producing cause, acted upon by the Appetitum, which is here the Primum Movens Immobile. But this Appetitum cannot act without coming into the intellectual sphere, as something seen, imagined, cogitated.* In this case the Nous or Intellect is stimulated through appetite, and operates in subordination thereto. Such is the Intellect, considered as *practical*, the principle or determining cause of which, is the Appetitum or object of desire; the Intellect manifesting itself only for the sake of some end, to be attained or avoided. Herein it is distinguished altogether from the theoretical Nous or Intellect, which does not concern itself with any Expetenda or Fugienda, and does not meddle with conduct. The Appetitum is *good*, real or apparent, in so far as it can be achieved by our actions. Often we have contradictory appetites; and in such cases, the Intellect is active, generally as a force resisting the present and caring for the future. But Appetite or Desire, being an energy including both soul and body, is the real and appropriate cause that determines us to local movement, often even against strong opposition from the Intellect.†

Aristotle thus concludes his scheme of Psychology, compre-

* Aristot. De Animâ, III. 10, 433, b. 12-17. *πρῶτον δὲ πάντων τὸ ὀρεκτὸν, τοῦτο γὰρ κινεῖ οὐ κινούμενον τῷ νοηθῆναι ἢ φαντασθῆναι.*

† Aristot. De Animâ, III. 10, 433, a. 25, b. 19. *ἐν τοῖς κοινοῖς σώματος καὶ ψυχῆς ἔργοις*, &c.

hending all plants as well as all animals; a scheme differing in this respect, as well as in others, from those that had preceded him, and founded upon the peculiar principles of his own First Philosophy. Soul is to organized body as Form to Matter, as Actualizer to the Potential; not similar or homogeneous, but correlative; the two are only separable as distinct logical points of view in regard to one and the same integer or individual. Aristotle recognizes many different varieties of Soul, or rather many distinct functions of the same Soul, from the lowest or most universal, to the highest, or most peculiar and privileged; but the higher functions presuppose or depend upon the lower, as conditions; while the same principle of Relativity pervades them all. He brings this principle prominently forward, when he is summing up* in the third or last book of the treatise De Animâ. 'The Soul (he says) is in a certain way all existent things; for all of them are either Perceivables or Cogitables; and the Cogitant Soul is in a certain way the matters cogitated, while the Percipient Soul is in a certain way the matters perceived.' The Percipient and its Percepta—the Cogitant and its Cogitata—each implies and correlates with the other; the Percipient is the highest Form of all Percepta; the Cogitant is the Form of Forms, or the highest of all Forms, cogitable or perceivable.† The Percipient or Cogitant Subject is thus conceived only in relation to the Objects perceived or cogitated, while these Objects again are presented as essentially correlative to the Subject. The realities of nature are particulars, exhibiting Forms and Matter in one; though, for purposes of scientific study—of assimilation and distinction—it is necessary to consider each of the two abstractedly from the other.

* Aristot. De Animâ, III. 8, 431, b. 20 seq. *Νῦν δὲ περὶ ψυχῆς τὰ λεχθέντα συγκεφαλαιώσαντες, εἴπωμεν πάλιν ὅτι ἡ ψυχὴ τὰ ὄντα πώς ἐστι πάντα. ἢ γὰρ αἰσθητὰ τὰ ὄντα ἢ νοητά, ἔστι δὲ ἡ ἐπιστήμη μὲν τὰ ἐπιστητά πως, ἡ δ' αἴσθησις τὰ αἰσθητά.*

† Aristot. De Animâ, III. 8, 432, a. 2. *ὁ νοῦς εἶδος εἰδῶν, καὶ ἡ αἴσθησις εἶδος αἰσθητῶν.*

A.—*Definition and Divisions of Mind.*—p. 9.

In defining the department of Feeling, it will be observed that the negative method has been resorted to; it being implied that the positive definition is attended with difficulties. Were all feelings either pleasures or pains, the definition would be easy enough. But there are feelings indifferent as respects pleasure and pain,—for example, surprise, which may be pleasurable or painful, but which often is neither, and is yet clearly a feeling. When we have occasion to draw a decided contrast between feeling and intelligence, we may quote pleasure or pain as unmistakeable modes or examples of feeling, but we must not be understood as affirming that there are no neutral or indifferent states.

In the first edition, I used the word 'Emotion' as a synonym of Feeling, on the ground that our so-called emotions—Wonder, Fear, Anger, Love—are generically identical with our Sensations; and that the fact implied by the word 'emotion,' namely, a certain stir of the bodily members, attaches to everything that could be called a feeling, whether sensation or emotion. I was anxious to do away with the supposed distinction between states of feeling accompanied with bodily manifestations, and states not accompanied with such manifestations, which distinction I believe to be erroneous. Nevertheless, I am disposed to defer to the criticism of Mr. Spencer upon this point, and to confine myself to the word 'Feeling,' as the generic name, of which Sensation and Emotion are the two species. I have, accordingly, ceased to employ the word 'emotion,' as the comprehensive name for the first department of the mind. With respect, however, to the adjective 'emotional,' used in contrast to the 'intellectual,' or the 'volitional,' I have not observed the same restriction. No adjective could be formed from the word 'feeling,' and yet it is often convenient to possess one. Thus, the senses are divisible into two classes, emotional and intellectual, the first being those where 'feeling' is the chief characteristic, and the second, those that minister to thought, or intellect.

I have also departed from the use of the word 'Consciousness,' employed in the first edition, as another synonym for Feeling. I employed that word for nearly the same reason as 'emotion' was used; namely, because whenever we are conscious, I believe that there is a physical accompaniment, essentially of the same nature, as the accompaniments of any salient emotion, although perhaps in a lower degree; and, farther, because consciousness does not necessarily attend intellectual operations. But I now prefer to give to the word a greater extension than mind proper, and make use of it to include our object states as well as our subject states. The object and subject are both parts of our being, as I conceive, and hence we have a *subject-consciousness*, which is, in a special sense, mind (the scope of mental science), and an *object-consciousness*, in which all other sentient beings participate, and which gives us the extended and material universe. Such a mode of employing the term I consider as highly serviceable in dealing with the great problem of Metaphysics.

The threefold division of Mind—into Feeling, Intellect, and Will—seems to have been first explicitly made in Germany, in the last century, by certain almost forgotten psychologists who flourished in the interval between Wolf and Kant. In so far as Kant troubled himself at all about psychology, or required psychological data, in executing his task of criticising the foundations of human knowledge, it was to the works of these, his immediate forerunners, that he had recourse. Thus, he followed their principle of the threefold division in laying out the parts of his whole critical undertaking; the *Critique of Pure Reason* corresponding to Intellect or the power of Cognition, the *Critique of Practical Reason* to Will or Action, and the *Critique of the Faculty of Judgment* to Feeling of pain and pleasure. But it was no part of his plan to work out the principle in a psychological exposition of mind.

As little did it come within Kant's scheme to give a scientific *definition* of mind. Still, if he was no psychologist, he was not, therefore, prepared to accept the common metaphysical assumption of the mind as a distinct substance, in its nature absolutely simple and immaterial. According to his criticism, this is a 'paralogism of the pure reason': the real nature of mind—mind as *noumenon*—is altogether unknowable by us, and so too of matter: the two *noumena*, if distinct, may be capable of entering into transcendental union so as to form the basis of our united external and internal experience, or there may be but one real or noumenal foundation underlying both internal and external phenomena—for anything we know; all that lies open to us is the *phenomenal* opposition as experienced. This opposition Kant was generally content to speak of under the phrases 'internal' and 'external.' One class of phenomena we have by 'the internal sense,' whose 'form' is Time; another class by the external senses, whose form is Space (and Time, indirectly). This would make External phenomena all come under the Extended; but Kant did not care to grasp the rest as the Unextended.

Since the time of Kant, amongst German philosophers Herbart is most worthy of note as regards the question of the definition and division of Mind. Recurring, after Kant's criticism, to a more positive doctrine, he gave a purely metaphysical definition of the mind or soul, as a simple unextended entity. This is not very far removed from the soul-monad of Leibniz, with whom Herbart farther agreed to some extent in his explanation of the difficulty regarding the connexion with the body which must attend every metaphysical definition of mind. Leibniz bridged the gulf between mind and matter by supposing the body itself, like all matter, to be made up of myriads of monads, each with a subjective life of its own, only of lower intensity than belonged to the central soul-monad. Herbart, for his part, explaining all union of attributes in things by supposing things made up of a number of *realia* each endowed with one special quality of its own, placed the soul-entity at one point of the brain, and assumed its relation to be with the metaphysical 'reals' composing the brain-matter. The single quality that, in conformity with his general doctrine, he ascribed to the soul-monad was *Vorstellen*, or the faculty of mental *presentation*. This may be taken to correspond to Intellect or Cognition, and back to it he traced Feeling and Volition: Feeling being a subjective experience arising differently as the presentations aid or repress each other in coming into full consciousness; Volition, an impulse joined to the presentation of a thing as attainable. It was in this peculiar sense that Herbart accepted the threefold division: he distinctly separated three elements, but sought to deny the primitive character of two of them. The failure of the attempt has often been remarked; for instance, he could not resolve Volition without dragging in such words as 'impulse' and 'attainable.'

His metaphysical point of view did not prevent Herbart from cultivating empirical psychology, and he has the credit of originating the great psychological movement that marks the latest period of German philosophy. Within his school the threefold division of mind has not been farther impeached; and outside, it has been frankly accepted. But German writers have not been in the habit of making it so distinctly govern the course of the exposition as has been done in this work.

Mr. Samuel Bailey adopts the threefold partition, which he words as follows:—I. SENSITIVE AFFECTIONS, comprising (1) Bodily Sensations, and (2) Mental Emotions. II. INTELLECTUAL OPERATIONS; enumerated as (1) Discerning, (2) Conceiving, (3) Believing, (4) Reasoning. III. WILLING; subdivided into Willing operations of the Body, and Willing operations of the Mind.

B.—*Physical accompaniments of Pleasure and Pain.*—p. 295.

Mr. Herbert Spencer, in an Essay on Tears and Laughter, has suggested that the convulsive movements of the Diaphragm, in Laughter, are of a nature to lessen the action of the brain. The effort made is, not to take in more air, but to take in less. By a series of convulsive muscular contractions, the contained air is as far as possible expelled; a short inspiration follows, and then another series of convulsive movements; and so on, till the laughter ends; we being then, as we often significantly say, 'out of breath.' The result of this must be a temporary falling off in the absorption of oxygen; a corresponding diminution of vital activity; and, by implication, a decrease of that high cerebral excitement of which laughter is a consequence. In crying, too, which, as shown, is accompanied by excess of cerebral circulation, the action of the lungs is in essence the same. The long and forcible expirations, and the short inspirations which characterize it, must similarly cause deficient oxygenation and its results.—(Essays, first series, p. 400.)

In a later work, Mr. Spencer has put forth an interesting speculation on the Physiology of laughter, founded on an analysis of the physical accompaniments of feeling, in many respects identical with the view that suggested itself to me, as best in accordance with the facts.

He says: 'Strong feeling, mental or physical, being, then, the general cause of laughter, we have to note that the muscular actions constituting it are distinguished from most others by this, that they are purposeless. In general, bodily motions that are prompted by feelings are directed to special ends, as when we try to escape a danger, or struggle to secure a gratification. But the movements of chest and limbs which we make when laughing, have no object. And now remark that these quasi-convulsive contractions of the muscles, having no object, but being results of an uncontrolled discharge of energy, we may see whence arises their special characters—how it happens that certain classes of muscles are affected first, and then certain other classes. For an overflow of nerve force, undirected by any motive, will manifestly take first the most habitual routes; and if these do not suffice, will next overflow into the less habitual ones. Well, it is through the organs of speech that feeling passes into movement with the greatest frequency. The jaws, tongue, and lips are used only to express strong irritation or gratification; but that very moderate flow of mental energy which accompanies ordinary conversation, finds its chief vent through this channel. Hence it happens that certain muscles round the mouth, small, and easy to move, are the first to contract under pleasurable emotion. The class of muscles, which, next after those of articulation, are most constantly in action (or extra action we should say) by feelings of all kinds, are those of respiration. Under pleasurable or painful sensations, we breathe more rapidly, possibly as a consequence of the increased demand for oxygenated blood. The sensations that accompany exertion also bring on hard breathing; which here more evidently responds to the physiological needs. And emotions, too, agreeable and disagreeable, both, at first, excite respiration; though the last subsequently depress it. That is to say, of the bodily muscles, the respiratory are more constantly implicated than any other in those various acts which our feelings impel us to; and hence, when there occurs an undirected discharge of nervous energy into the muscular system, it happens that, if the quantity be considerable, it convulses not only certain of the articulatory and vocal muscles, but also those which expel air from the lungs. Should the feeling to be expended be still greater in amount—too great to find vent in these classes of muscles—another class comes into play. The upper limbs are set in motion. Children frequently clap their hands in glee: by some adults the hands are rubbed together; and others, under still greater intensity of delight, slap their knees and sway their bodies backwards and forwards. Last of all, when the other channels for the escape of the surplus nerve-force have been filled to overflowing, a yet further and less used group of muscles is spasmodically affected: the head is thrown back, and the spine bent inwards—there is a slight degree of what medical men call *opisthotonos*. Thus, then, the muscles first affected are those which feelling most habitually stimulates; and as the feeling to be expended increases in quantity, it excites an increasing number of muscles, in a succession determined by the relative frequency with which they respond to the regulated dictates of feeling.'—(Essays, Second Series, p. 111.)

That the impulse that causes a feeling tends also to produce bodily movements, is to my mind incontestable. And I think that Mr. Spencer's remark as to the natural priority of the movements in muscles small in calibre and often exercised (or, as he elsewhere expresses it, that the influence operates first in the line of least resistance), is sufficient to explain the selection of the features as organs of expression by pre-eminence. The tendency of the breathing functions to be soon affected, also falls under the same principle.

It appears to me, however, that Mr. Spencer, by omitting to study the difference of manifestations under pleasure and under pain, has not only left his theory incomplete, but has made statements that are too sweeping. He admits that disagreeable emotions in the end depress the respiration. He speaks of a few 'apparently exceptional cases, in which emotions exceeding a certain intensity produce prostration,' but maintains, nevertheless, that, as a general law, alike in man and in animals, 'there is a direct connexion between feeling and motion; the last growing more vehement as the first grows more intense.' My view is, on the contrary, that the law of increase of movements by increase of feeling, should be applied only to pleasurable feelings. I hold that when a stimulation is of a kind to cause pain, the general rule is, that it abates instead of originating movements. A blow sufficiently severe will bring the activity to a stand-still at any moment; a smaller blow will show itself in a partial stoppage of energy. I am not unaware of the exceptions to this rule; they have been dwelt upon in the text. But these exceptions are very far from subverting the rule to the extent of classing the painful and the pleasurable stimuli under one head. I agree with Mr. Spencer that force is never lost in the animal system, and that, in the case of every sensation, we should enquire—'where is all the nervous energy gone?' but I am quite able to render a full account of the effects of a hurt; they are the destruction of the pre-existing energy of the system, the rupturing of the tissues, and the perverting of the natural functions. They are negative, or hostile influences; they put an arrest upon our movements, instead of increasing them. This arrest I look upon as the primary and proper effect of the agencies of pain; while the appearances of heightened energy that would seem to confound pain and pleasure, are but the occasional and temporary operation of another law of the animal organization.

Kant, in a passage quoted by Sir W. Hamilton (Metaphysics, ii. 472), appears to have regarded pleasure as connected with Conservation. The following sentences, separated from a number of very confusing statements in the immediate context, are to this effect: 'Pleasure is the feeling of the furtherance *(Beförderung)*, pain of the hindrance of life. Under pleasure is not to be understood the feeling of life; for in pain we feel life no less than in pleasure—nay, even perhaps more strongly. In a state of pain, life appears long, in a state of pleasure, it seems brief; it is only, therefore, the feeling of the promotion or furtherance of life, which constitutes pleasure. On the other hand, it is not the mere hindrance of life which constitutes pain; the hindrance must not only exist, it must be felt to exist.'

Sir W. Hamilton has propounded a theory of pleasure and pain, subtantially identical with the definition given by Aristotle (Nicomachean Ethics, Book X.). It is summed up in these words: 'Pleasure is the reflex of the spontaneous and unimpeded exertion of a power, of whose energy we are conscious. Pain is a reflex of the overstrained or repressed exertion of such a power.' It is no part of my present plan to enter fully into the theory of pleasure and pain; the present discussion has been exclusively turned upon the physical concomitants, which in all the theories quoted by Sir W. Hamilton, are mixed up with purely mental considerations. I will only remark that the theory of Aristotle, as rendered by Hamilton, making pleasure the concomitant of the 'unimpeded energy of a natural power, faculty, or acquired habit,' by excluding passive pleasures (a warm bath, for instance), is obviously one-sided. The case is not bettered by giving to energy a meaning so wide as to include our passive sensibilities; the definition is thereby rendered so vague as to be quite worthless. The adoption of such a theory is interesting only as throwing light on the individuality of the holder.

C.—*The Germs and the Development of Volition.*—pp. 305, 413.

In a note (p. 415) I have given observations made upon two new-born lambs, as illustrating the origin and progress of voluntary power. I have since had opportunities of making observations on the first movements of the calf, which bore out the main points stated in the other case. It was a matter of ocular demonstration, that the new-born calf at first did not know which way to move to approach the cow, and had no notion of the udder or of its whereabouts.

I have interrogated shepherds as to the circumstances attending the birth of lambs, and especially as to their ability to find out for themselves the mother's teats. I have been told in reply, that when the ewe and the lamb are both vigorous, they come together very soon of their own accord; but if one, or other, or both, are weakly, assistance must be given, otherwise the lamb is in danger of perishing before it can find its way to the teat. This was the most pertinent statement that I could elicit, and it is strongly confirmatory of the general doctrine advanced in the text, namely, initial spontaneity working under trial and error, the successful strokes being clenched and sustained under the law of Conservation. Great physical vigour in the lamb is necessarily accompanied with an abundant spontaneity, the essential condition of a favourable start or commencement in the process of volitional acquisition.

I have stated, under the title of the principle of Self-conservation, what I deem the primitive link that connects action with feeling. This has been expressed by Mr. Spencer, with reference to the lowest forms of life, in the following terms:—'Thus, there is not a little reason to think, that all forms of sensibility to external stimuli, are, in their nascent shapes, nothing but the modifications which those stimuli produce in that duplex process of assimilation and oxidation which constitutes the primordial life. No part of the tissue of a zoophyte can be touched, without the fluids diffused throughout the adjacent parts being put in motion, and so made to supply oxygen and food with greater rapidity. Nutritive matter brought in contact with the surface, which, in common with the rest of the body, assimilates, must cause a still greater excitement of the vital actions ; and so must cause the touch of organic substance to be more promptly responded to than that of inorganic substances. A diffusion of nutritive matter in the form of an odour will tend, in a slight degree, to produce analogous effects.'—(Psychology, p. 403.)

Mr. Spencer has not, as it seems to me, made the full use of this hypothesis in his subsequent explanations of the growth of volition. Such an assumption is requisite in order to explain why certain movements, out of a great number happening, are retained by preference, so as to enter into a cohering union with definite states of feeling.

D.—*Seat of revived impressions.*—p. 346.

The following additional illustration, regarding the physical seat of revived impressions, is given by Wundt. 'If we look long at green light, a white surface, when we turn to it, appears red ; if we look long at red light, the white surface appears green. Thus, every picture of an external object leaves behind it an after-picture, which has the same outline as the original picture, but is seen of the complementary colour of the original. Now, a picture of the fancy leaves, though generally much less intensely, an after-picture too. If, with the eye closed, a picture of very lively colour is for a long time steadily held fixed before the fancy, and the eye be then suddenly opened and turned upon a white surface, the picture of the fancy is seen upon the white ground for a short time of a colour the complement of the original. This can take place, only because the eye has been wearied by the sameness of the colour of the picture of the fancy, and needs to seek relief in its complement, just as it would do with a real coloured object before it. The experiment proves that the nervous process in both cases is identical.' Kant, also, in one of his minor works, wishing to oppose the opinion that the soul or thinking principle resides only in the brain and in one part of it, meets the argument adduced from the feeling we have in the head in hard thinking, as follows :—'What causes the thinking soul to be felt chiefly in the brain, is perhaps this. All thought requires the mediation of *signs*, which may support the ideas to be aroused and give the necessary degree of clearness. Such companion signs for our ideas are for the most part obtained through hearing and sight, both which senses are set in action by the impressions in the brain, since their organs lie nearest to it. If, now, the rousing of these signs, called by Descartes *ideæ materiales*, be properly a stimulation of the nerves to an activity resembling that which formerly brought about the sensation, the tissue of the brain in the act of thinking will fall to be affected in harmony with former impressions, and thereby become exhausted.' Here we have a partial recognition of the theory contended for in the text.

Sir W. Hamilton maintains substantially the same view in the following passages :—'I shall terminate the consideration of Imagination proper by a speculation concerning the organ which it employs in the representation of sensible objects.' 'But experience equally proves that the intercranial portion of any external organ of sense cannot be destroyed, without a certain partial abolition of the Imagination proper. For example, there are many cases recorded by medical observers of persons losing their sight, who have also lost the faculty of representing the images of visible objects. They no longer call up such objects by reminiscence, they no longer dream of them. Now, in these cases it is found that not merely the external instrument of sight —the eye—has been disorganized, but that the disorganization has extended to those parts of the brain which constitute the internal instrument of this sense, that is, the optic nerves and thalami. If the latter, the real origin of vision, remain sound, the eye alone being destroyed, the imagination of colours and forms remains as vigorous as when vision was entire.' 'But not only sensible perceptions, voluntary motions likewise are imitated in and by the imagination. I can, in imagination, represent the action of speech, the play of the muscles of the countenance, the movement of the limbs; and, when I do this, I feel clearly that I awaken a kind of tension *in the same nerves* through which, by an act of will, I can determine an overt and voluntary motion of the muscles; nay, when the play of imagination is very lively, this external movement is actually determined.'—(Metaphysics, ii., 169, 274.)

I quote farther a few sentences from Mr. Spencer's theory of Memory. 'To remember the colour red, is to have, in a weak degree, that psychical state which the presentation of the colour red produces; to remember a motion just made by the arm, is to feel a repetition, in a faint form, of those internal states which accompanied the motion—is an incipient excitement of all those nerves whose stronger excitement was experienced during the motion.'—(Psychology, p. 359.)

E.—*Perception of the Material World.*—p. 384.

I shall here advert to the mode of solving this great problem agreed on by some of the most distinguished philosophers of the present day.

Sir W. Hamilton has examined the subject at great length, recurring to it in many parts of his writings. I select the following quotation as sufficiently expressing his views:—'In the act of sensible perception, I am conscious of two things—of *myself* as the *perceiving subject*, and of an *external reality*, in relation with my sense, as the *object perceived*. Of the existence of both these things I am convinced; because I am conscious of knowing each of them, not mediately in something else, *as represented*, but immediately in itself, as *existing*. Of their mutual dependence I am no less convinced; because each is apprehended equally and at once, in the same indivisible energy, the one not preceding or determining, the other not following or determined; and because each is apprehended out of, and in direct contrast to, the other.'—(*Reid*, p. 747.)

Mr. Samuel Bailey, in his *Letters on the Philosophy of the Human Mind*, has exposed, with great clearness and force, the equivocations of language and confusion of ideas that have clouded the question of external perception. His own view is expressed in the following sentence—'It seems to have been only after a thousand struggles that the simple truth was arrived at, which is not by any means yet universally received—the truth that the perception of external things through the organs of sense is a direct mental act or phenomenon of consciousness, not susceptible of being resolved into anthing else.'—p. 111.

Mr. Herbert Spencer, after reviewing the whole question at length (Principles of Psychology, Part I.), arrives at the following conclusion—' These positions being granted, it inevitably results, as we have found, that the current belief in objects as external independent entities, has a higher guarantee than any other belief whatever—that our cognition of existence considered as noumenal, has a certainty which no cognition of existence, considered as phenomenal, can ever approach; or in other words —that, judged logically as well as instinctively, Realism is the only rational creed; and that all adverse creeds are self-destructive.'—p. 59.

Now, with regard to this theory of Realism, so emphatically vindicated by these three great speculative thinkers, I must still take leave to demand the *meaning* of an external and independent reality. If the answer be, that this also is given to us in consciousness, as a simple, ultimate, unanalyzable, inexplicable notion, like colour or heat, I dispute the assertion. I deny the ultimate nature of all three notions—' external,' ' independent,' and ' reality.' Every one of them admits of being explained, analyzed, or resolved into other notions. The idea of ' externality,' as applied to the object world, is a figurative employment of the notion that we obtain in our experience of extended things. We see an extended object—as a field, with some cattle grazing within its enclosure, and others grazing without—and by comparing all such experiences, we obtain the idea of externality, which we apply to the object-world as compared with the subject-world. The application is, at best, but figurative; the cases are not parallel. The parallelism applies properly to our *bodies* as compared with surrounding objects; it applies to mind only by the questionable mode of representing the mind as a something enclosed in the body.

Again, how do we come by our notion of ' independent?' Is it not by a study of the complicated arrangements of the world about us? This is far from an elementary idea. Children do not understand it at first. It is an abstraction from a certain class of facts gradually disclosed in our experience. Moreover, it is applied to the relation of subject and object with still less of relevance than the foregoing. Indeed, this is the word that has insinuated into men's minds that erroneous opinion, which Berkeley criticised, and which has had to be abandoned—the theory of a world existing apart from mind, but, coming into contact with mind, so as to impress thereon images or ideas of itself. Not only is the word inapplicable, as it seems to me, but the application of it is opposed to the facts of the case. 'In dependence' is neither an ultimate conception or notion, nor a suitable derived conception, in the present instance.

Lastly, I would appeal to any candid person to say, if 'reality' is a simple, unanalyzable, notion, fit to enter into an axiomatic or ultimate truth of consciousness. It is an exceedingly subtle and complex notion, obtained from the examination of a wide range of facts. The term is very vaguely understood by the generality of persons. As applied to the theory of perception, it is obscure in an especial degree.

Thus, then, I object to the Realistic creed, as presenting to us a statement involving terms of complex and derived signification, of doubtful meaning, and of unsuitable application. I cannot call the theory altogether false, any more than I can call it true. It is simply irrelevant. It is a crude figurative mode of expressing the greatest distinction that we can draw within our conscious life; it suits the commoner purposes of mankind; but it is, in my opinion, altogether unworthy of the name of philosophy.

I have made an attempt, in the text, to arrive at an analysis of the great and radical contrast of the Object and the Subject. I consider that, before invoking consciousness to attest a fact, the fact itself should be reduced to its primitive and indivisible elements. Such doctrines as an External world, the Freedom of the Will, a Moral Sense, are not in a shape to be submitted to the test of our consciousness, as I have endeavoured to point out elsewhere ('Emotions and the Will,' Liberty and Necessity, § 9). The truths of consciousness ought to be axiomatic in the strict sense of the word; they should involve only ultimate notions.

I am well aware that this analysis has not given universal satisfaction. The following is an example of the kind of criticism it has met with.

'According to this, to see the sun in the heavens is to believe that, if we could only keep on walking long enough, we might burn our fingers; to descry the lark aloft, is to recite, by muscular sympathy, the beating of its wings since it left its nest;

to think of any distant space, is to run over our locomotive sensations in reaching it, and the opportunity of thrusting out our own arm, when we have got there. Emptiness means simply scope for muscular exercise; and the infinitude of space imports only potential gymnastics for us under all conceivable circumstances. This kind of analysis of our ideas, seems to us, we must confess, a cruel operation—a cold-blooded dissection of them to death. The *disjecta membra*, given as their equivalents, and strung together in succession to replace the original whole, defy all identification. Look down an avenue of trees, and consider whether, in appreciating its perspective, you are engaged on the mere imagination of touches, or the computation of fatigue?'

I must leave the reader to judge whether a philosophical analysis is to be refuted by the epithets 'cruel' and 'cold-blooded,' even if truly applied. Scientific explanations have often a repulsive and disenchanting effect; and the scientific man is not made answerable for this. To the reasons given against the adequacy of the analysis, I am bound to furnish a reply.

When I walk down an avenue of trees, the import of what happens to me is contained in these four particulars:—I am putting forth muscular energy; my sensations of sight are changed in accordance with my muscular energies; the sensations of my other senses arise in the same uniform connexion with my energies; and, lastly, all other beings are affected in the same way as myself. When I look down the avenue, without walking down, the sight alone reveals all those facts, owing to frequent association, and reveals no other facts. It tells me what would happen to me, and to any other beings constituted like me, if we were to walk down. It recalls the actual experiences of conjoint energies and sensations, in the past, and anticipates the like in the future. This I take to be the simple revelation of consciousness, and all that consciousness can reveal, or that it concerns us to know. If an external and independent reality means anything besides those muscular feelings and sensations, and their mutual dependence, it is something that I am unable to imagine, and that would serve no end. People, no doubt, will ask, is the external universe merely an appendage of the collection of minds, vanishing when they are gone? Are we to believe that if all minds were to become extinct, the annihilation of matter, space, and time would result? I reply, this is not a fair statement of the case. I may, if I please, still speculate upon the certainty of an extended universe, although death may have overtaken all its inhabitants. But my conception, even then, would not be an independent reality, I should merely take on the object-consciousness of a supposed mind then present. I should conceive nothing but states of muscular energy, conjoined with sensation.

Of the four particulars contained in the analysis, the last is what has most contributed to suggest the externality and independence of our object consciousness. When other beings are found to be affected by the same sensations, on performing the same movements, there appears to be an elimination of personality, or of all special or individual characteristics. We think we cannot mark the contrast strongly enough, by any process short of cutting each one's being into two parts, and depriving it of the part held by us in common, because it is in common. But I still contend, that the separation is only a figure of speech, which, like many other figures, has a rhetorical use while involving a contradiction in logic. The past existence and future persistence of the object-universe can mean to us only that if minds existed in the past, and are to exist in the future, they would be affected in a certain way. My object consciousness is as much a part of my being as my subject consciousness is. Only, when I am gone, other beings will sustain and keep alive the object part of my consciousness, while the subject part is in abeyance. The object is the perennial, the common to all; the subject is the fluctuating, the special to each. But there is nothing in the fact of community of experience (the object) that justifies us in separating the experience from the alliance with mind in the strict sense (the subject).

The new Realism is little better than the old popular notion, with Berkeley gagged.

F.—*Contiguous Association in the ideas of Natural Objects.*—p. 417.

A critic in the 'National Review' has represented 'this order of derivation, making our objective knowledge begin with plurality and arrive at unity,' as 'a complete inversion of our Psychological history.' He considers, in opposition to the explanations in the text, 'that each state of consciousness, whether awakened through more or fewer channels, is, during its continuance, originally simple, and resolves itself only by change of equilibrium.' 'Experience proceeds, and intellect is trained, not by Association, but by *Dissociation*, not by reduction of pluralities of impression into one, but by the opening out of one into many.'

I was perhaps wrong in not guarding my exposition in the place alluded to, by the statement, that I was illustrating not the first steps of all in our cognition of things, but a later stage in our education, when we have obtained our elementary conceptions of body, and are engaged in combining these in all the varieties presented by nature. In treating of the first origin of our notions of form, colour, hardness, &c., a very different line of remark from that in the text would have to be pursued. But we soon arrive at a period of life when these notions are formed, and when we recognize any new concrete object presented to us, a building, for example, as a compound of form and effects of colour, and lay it up in our memory by the association of those notions. The education of the mineralogist, botanist, zoologist, proceeds, at the stage I am supposing, by association wholly. The objects of their several studies are aggregates of qualities in the acceptation of the text. I supposed the primary constituents of the different conceptions to have been obtained by the mind, which is the condition recognized by the critic as enabling the principle of Association to come into play.

I have, in various parts of my two volumes, discussed the primary origin of our ideas, so far as we are able to reason back to the dawn of intelligence; and, in the concluding chapter of 'The Emotions and the Will,' I have dwelt upon the fundamentals of cognition, some of my statements on that subject obtaining the approval of the same reviewer. But I am bound to mention, that my able contemporary, Mr. Spencer, has, while adopting substantially the same views as mine, developed this part of the subject with a systematic completeness peculiar to himself.—(Psychology, Part ii., Chapters on Perception, 9-17.)

It must be admitted, as the reviewer remarks, that the first presentation to consciousness of an object, afterwards accounted complex, does not necessarily give a feeling of complexity. The first effect of any new presentation is an indefinable shock to the mind, a rousing of consciousness, by the mere circumstance of change of impression. It is impossible to describe this consciousness as either single or complex; it is better considered as purely vague. If the state passes away, and, after an interval, when the mind has had other shocks, is reproduced, there arises with it the consciousness of identity, or recognition, which is a step towards determining and defining its character. If it is a sensation of cold, we are led by it to reinstate the previous states of cold; and the comparison has the effect of singling out and detaching this experience from others, an effect already commenced by the consciousness of the difference between it and other states. No long time is necessary to recognize the complexity of our sensations; for, if we see a fire, and feel the warmth, we dissociate the conjunct impression by identifying the sight with former impressions of the same colour, and the warmth with former experiences of warmth. As soon as we have a *past* to refer to, however limited, we separate every compound sensation into its elements. If the first sensation that combined light and warmth be vague and unanalyzable, two or three experiences, where these occur in different connexions, would lead to a commencement of the disentangling consciousness. Each element in a compound would recall the previous impressions of that element; heat would bring up heat, blackness would go on the old track of blackness, and so on. We cannot tell how soon this process would be distinctly possible; it matters little what the precise lapse of time is; we can see that the mind after an experience, longer or shorter, must arrive at the state representing our habitual conduct in the matter—namely, that every complex sensation is instantaneously taken to pieces by filing every separate ingredient on its own thread. The round figure of a pebble revives the accumulated impression made by all experiences of roundness; the colour is fused with all the previous impressions of that colour; the hardness brings back the sum total of traces of the same hardness, and so on. Hence, Mr. Spencer justly describes perception as a process of *classification*. Of course there can be no perception until some accumulation of separate impressions has taken place; but it cannot be long ere we are prepared to make a beginning in the work. As a compositor distributing types effectually disintegrates his compound impression of a word, by tossing an *a* with the *a*'s, and an *n* with the *n*'s, so we require a foregone reference for each item of a compound sensation; but when this has been obtained by means of our growing stock of agreeing impressions, we are prepared for the work of combining and associating in the manner attempted to be explained in the text. Not to say that the *dis*sociation was operated only through an association (of similarity) for every element separately.

G.—*Subjective studies and regards.*—p. 442.

The Objective direction of the mind implies the exercise of the *senses* upon the various properties of the Object world, with the least degree of attention even to the pleasures and pains growing out of this exercise. Extension, Form, Colour, Sound, and the chief Tactile properties, belong to our objective attitude. They cannot be taken cognizance of in an absolute void of subjective regards, since the motives to attention are, in the last resort, feelings, that is, elements of the Subject. In the inferior, and more exclusively emotional, senses,—Smell, Taste, Organic Life,—subjectivity is more developed, and attains its maximum in the Organic sensations.

The Object attitude farther includes *reflection* on object properties, as when the geometer studies a problem mentally, or an engineer meditates his plans before putting them on paper. In these situations, the mind is conversant with subject elements, in the form of ideas; but it thinks of these ideas as representing object realities; it does not make a study (as a psychologist would do) of the successions of ideas as exemplifying mental laws.

The study of the sciences of the so-called External, or the Object, world, is purely an object attitude. In none of them is it absolutely necessary to be subjectively engaged. In the practical science named Logic, maxims may indeed be derived from the study of mind; in Ethics, this is so to a still greater degree; but to that extent, Logic and Ethics are conversant with the subject mind.

The various practical arts and operations conversant with object properties (Agriculture, Manufactures, Navigation, &c.) evoke the object regards by almost exclusive preference. Except in the motive (the *end* of Aristotle), which must ever be some feeling—pleasure or pain—such arts do not strictly involve in their machinery anything introspective. The exception to the rule will be noticed presently.

Even as regards the mind itself, our knowledge is not necessarily, or wholly, subjective. It must be so in part; but as every mental fact has a physical counterpart, and every mental sequence runs side by side with a physical sequence, we may, and often do, remain content with the physical aspect, and may image the phenomena to ourselves under that aspect exclusively. Such is the form wherein we embody our knowledge of the inferior animals; we make little or no attempt to penetrate into their consciousness; perhaps when they give evidence of acute pain, or acute pleasure, we have a certain subjective sympathy with those states; but we think of their characteristics mainly under the objective manifestations, their likings and dislikings are imaged under a variety of movements and bodily configurations, like a spinning jenny or the working of a ship.

In nearly the same exclusively objective forms, we can study, and think of, our fellow-men. We may refrain from conceiving their pleasures, pains, emotions, ideas, in the subjective character; we may think of them all through the allied object appearances:—such objective circumstances as material abundance or material privation, and the objective displays in action, gesture, and language, in symptoms of health or disease, life or death. We may even maintain a certain propriety of conduct towards our fellows, while considering their interests solely on the objective side. There is comparatively greater precision and certainty in dealing with this outward side; our senses can tell us whether any one has had an average meal, or the usual amount of clothing; and whether the person has a satisfied cheerful look, or very much the reverse.

The practical management of human beings may be conducted (not badly) on the same subjective method. A military commander may image or conceive his army purely as a fighting engine, requiring material supports, and displaying itself to the eye of sense by marching and fighting, and by outward expressions of contentment or displeasure. He may never think of their proper feelings at all; perhaps he is too exclusively bent upon object regards, to be often aware of his own.

Nevertheless, the knowledge of beings endowed with mind is not complete, not thorough, without, to some extent, coupling the subject study with the object study: as will be seen when we consider the precise nature and results of a subjective reference.

1. We are in a subject state, if we are under Feeling, as when alive to pleasure and pain. It is finally on account of these that we exist; for these we are prompted to objective exercises and regards: yet in the moments when the object attitude is triumphant, the feelings that induced it are under an eclipse; we have to remit the object strain, at intervals, to allow either pleasure or pain to be felt or to come into consciousness. Now, as human beings rarely exist in the exact mean in anything, there may be an excessive tendency to the object attitude, brought about chiefly by great spontaneous activity, and by the predominance of the object senses—sight, touch, and hearing; whence too little space is given to the subjective expansion even of moods of pleasure. The tracts of objective indifferentism may encroach upon our positive enjoyments, since these demand a certain frequency of relapses into the subject attitude. Subjectivity enlarges the area of feeling, both pleasurable and painful; to our gain, if pleasure is the ascendant fact, to our loss if pain predominates.

2. The Subjective attention is necessary to the recollection of our pleasures and pains, as such, or on their purely mental side, the side wherein lies their power as motives. The object side of pleasure and pain,—the outward means of procuring the one or avoiding the other, has a motive force, but only by association with the subject fact; and it needs to be re-invigorated and corrected by consulting the subject experience. The subjective study is the only way of estimating things at their real worth; it teaches exactly what every agent does for us in the final appeal. Not to bestow this amount of study is to leave ourselves at the mercy of irrational fixed ideas, as wealth or the contempt of wealth, honour, power, affection, length of life, and other things. Subjectivity contains the part of the philosophic habit that has regard to the intrinsic value of each worldly good, which is the measured subjective value, ascertained by self-consciousness, and by an accurate memory and comparison of experienced pleasures and pains.

Thus, although without Subjectivity man may be tolerably careful of the usual outward aids and adjuncts to happiness, it is yet indispensable to the highest development of Prudence. It is also, to the same extent, favourable to the fullest and truest forms of Sympathy, or to the appreciation of the exact conscious experience of others, as distinguished from their outward circumstances and manifestations.

3. The subjective tendency is also necessary to the delicate sense of right and wrong. Ethical self-examination, to be thorough, must be conscious, having regard to the feelings, motives, or intentions of the actor. It may not, however, be essential to rectitude in all degrees, but only to the highest degrees. The Stoical morality, as seen in Marcus Aurelius, was intensely subjective; so also is the highest morality of the modern world.

The best practical mode of seizing the ideal balance of the objective and subjective regards, is, in the manner of Aristotle, to study the extremes.

The objective regards have these signal advantages. They are favourable to activity; they promote health; they subdue both a considerable amount of pain, and also morbid broodings and discontents. They alternate the outbursts of pleasure with large periods of satisfied indifference; thereby enhancing enjoyments when they come. The delineation of Plot-Interest is the illustration of these advantages.

The disadvantages of too great Objectivity are expressed by the negation of what has been said in favour of the subjective regards.

The disadvantages of excessive Subjectivity are also implicated in the above remarks. Explicitly, they may be described as an inactive, unhealthy, morbid preying upon self; an aggravation of painful states generally; an extreme occupation of mind with organic feelings, called hypochondria; a tendency to push ethical self-examination to the point where it brings misery rather than a stimulus to duty; a mysticizing disposition to convert subjective abstractions, as soul, will, conscience, into independent existences; an extreme idealism, with a distaste for the practical world as it is; a susceptibility to opposition and to reproach; a revulsion against the coarse, indiscriminate energy of the objective man.

The ancient world, compared with the modern, was objective. Homer, as a poet, was in the objective extreme; Wordsworth is near the other extreme. Shakespeare has strong subjective leanings; but, in him, there is a good mixture of both.

The excess of subjectivity is seen in the religious mystics.

An admirable example is introduced by Goethe, into 'Wilhelm Meister,' under the title 'Confessions of a Fair Saint.'

Adam Smith's 'Theory of Moral Sentiments' is a continuous subjective exposition; his language and illustration preponderate towards subjectivity.

4. The study of the mind, as a science, must contain an element of introspection. There is difference of opinion as to what ratio this should bear to the objective study of the physical concomitants of the mind. Some psychologists define the science of mind, as the science of the facts of Consciousness, meaning Self-consciousness or subjectivity; as, for example, Hamilton and Cousin. Auguste Comte, in his 'Cours de Philosophie Positive,' rejected self-consciousness as a source of mental knowledge, and proposed an exclusive reference to the material adjuncts, as exhibited in the Physiology of the brain. The only tenable position is the combination of both.

H.—*The Abstractions—Number, Time, and Space.*

In the great controversy as to whether our entire knowledge is derived from *experience*, or whether part of it is derived from an *intuitive* source, the supporters of the last-named view have given various enumerations of the elements declared to be intuitive or innate. Those elements are stated either in the shape of *Notions*,—as Time, Space, Cause, or in the shape of *Principles*,—as the axioms of Mathematics, and the law of Causation. In point of fact, however, the same intuition is stated sometimes as a notion, and sometimes as a principle. Thus the intuition of space is considered identical with the intuition of the geometrical axioms. The notion 'cause,' and the law of cause and effect, must be treated as the same thing in a different form of speech.

For example, Mr. Mansel's enumeration of innate elements (exclusive of the moral sentiment) would probably be exhausted by the *notions*—Time, Space, Cause, Substance, together with the *principles* of Identity, Contradiction, and Excluded Middle (called the Laws of thought). Each of the notions could at will be expressed in the form of principles. It is sometimes said, that the axioms of Geometry flow out of, or are derived from, the notion of Space; but, more correctly, the notion and the axioms are to be held as the same intuition in an altered dress.

Number. Of all the attributes of things knowable to us, the most comprehensive and widely-spread is Quantity. We cannot be conscious at all without the consciousness of more or less—of degree, or quantity. Our very first acts of discrimination and of identification have reference to the degree of our feelings; of two differing sensations of light, one is felt as more intense than the other; of two muscular energies, we recognize the difference of amount. It is the same with pleasures and pains, and with feelings of every description. The property called degree is inseparable alike from object states and from subject states. We even discriminate different modes of degree; we distinguish the fact of *continuance* from the fact of *intensity*, and estimate the degree of each by comparison with its own kind; one day is longer than another; one flame is brighter than another.

Our estimate of degree is more or less delicate according to the quality of the sense concerned. In the higher senses—sight and hearing, our discrimination is at the maximum as in the interesting case of visible, or retinal, magnitude.

Quantity, or degree, is familiarly divided into two kinds—*continuous* and *discrete.*

Continuous or unbroken quantity is the more typical form. Its best example is the Duration of a continuous impression—the continuance of a muscular exertion, a sound, a pleasure. It farther applies to Extension, whose primary measure is the continuance or duration of movement. It does not apply to *intensive* quantity, or the comparison between a stronger and a weaker impression, as the loudness of a sound, or the brilliancy of a light.

Discrete quantity is the same as *number.* It supposes our impressions to be interrupted, or changed; and takes advantage of the effect of sudden change in making us acutely conscious, or mentally wakeful. In the case of breaks, or interruptions, we note the *frequency* of the transitions; we mark the difference between a transition made once, and a series of those transitions—two, three, four, and so on. This is Number. It is in various ways a remarkable experience. In the first place, it is given by every sensibility that we possess. By Aristotle, it was accounted one of the common perceivables, or the notions attained through all our senses alike; which is true, but not the whole truth. We have it by every one of our emotions; we distinguish a day when we had one surprise, one fright, one fit of anger, or one burst of tender feeling, from a day when we had two or three such experiences. We have it from the flow of our ideas, which are interrupted or discrete effects.

In the second place, Number is our best and most accurate means of estimating quantity. The most delicate of our sensibilities—visible magnitude, may be to some degree inaccurate; two persons may differ as to whether two rods exactly coincide in length; but nobody was ever mistaken in the difference between one and two. Hence the highest art of measuring both continuous quantity, and intensive quantity, consists in resolving each into discrete quantity; the beats of a clock are a surer measure of time than the place of the hands between the dial figures.

Probably no one now contends that Number is an intuition, or a 'form of thought,' provided by nature beforehand. It is a fact inseparable from the nature of our feelings; if these are intermitted and resumed, they are, by that very circumstance, numbered; and if our consciousness is interrupted by beats, or transitions, it is a consciousness of number.

Time. This is one of the intuitive 'forms' of the *à priori* school. The Experience-psychology treats it as an abstraction from particulars. In our feeling of the *continuous*, whether in movement, in sensation, in emotion, or in intellectual strain, we have a consciousness of degree, and that consciousness is the fact called Time, or Duration. Time in the abstract, is the generalization of all these modes of the continuous, and apart from these, or prior to these, it does not exist. We cannot be conscious of two movements being differently prolonged,—as, for example, lifting (at the same pace) a weight one foot and lifting it two feet—without having a particular experience of duration; we could not be deprived of that cognition, without being deprived of our discriminative muscular sensibility. If this be so, a form of thought pre-existing in the mind, corresponding to Time, is a superfluity; it could add nothing to our particular experiences of duration; and our generalizing faculty can obtain out of these whatever is meant by Time in general, or in the abstract.

Space. The origin of our notion of the Extended, the characteristic property of the object world, has been traced in its successive stages, under the heads of Muscular Feeling (p. 95), Touch (p. 181), Sight (p. 234), External Perception (p. 371). It will, of course, be inferred that I do not regard it as an intuition of the mind, a form of thought, or an element transcending our actual experience. By such steps as I have endeavoured to describe, we derive our notions of extended things,—of extension in the concrete. And from this we can obtain an abstract notion of the extended, in the same manner as we gain any other abstract notion, as colour, heat, or justice.

The Kantian doctrine, which regards Space and Time as forms of thought, and not products of our experience, has been examined and, as I think, decisively refuted by various writers, among whom I may name Mr. Spencer (Psychology, pp. 52, 244, 309) and Mr. Bailey (Letters on the Mind). I do not here propose to argue the point. My plan has been to exhibit what seems to me the genesis of the notions; and if that is satisfactory to the reader, an *à priori* origin is disproved by being superseded. The objections urged by Locke against innate notions generally have never, to my mind, been repelled; and they have been reinforced since his time. It may be granted, however, that Locke did not succeed in explaining how we come by such notions as Space, Substance, and Power. The five senses, as commonly understood, are inadequate to the purpose. I am satisfied, however, that when the muscular feelings are fully taken into the account, the difficulty exists no longer. The *à priori* notion of space has a shadowy and evanescent character in the hands of Sir W. Hamilton, who concedes an *empirical* knowledge of extension, as an element of 'existence.' He proposes to give 'the name *extension* to our empirical knowledge of space, and to reserve the name of *space* for space considered as a form, or fundamental law of thought.' I confess myself altogether unable to follow him in constituting a difference between (empty) extension and space.

I.—*Classification of the Intellectual Powers.*

The Intellectual powers were classified by Reid as follows:—*External Senses; Memory; Conception*, or Simple Apprehension; *Abstraction*, under which he discussed the questions of Nominalism, Realism, &c.; *Judgment*, or the theory of Common Sense as a basis of truth, the distinction between Necessity and Contingent Truth, &c.; *Reasoning*, which contains under it Demonstration and Probable Reasoning; *Taste.* He does not specify Imagination, nor allude to it, except indirectly under Taste.

Dugald Stewart added to the above scheme Consciousness, Attention, Association of Ideas, and Imagination; and omitted Taste. His enumeration stands thus:—*Consciousness; External Perception; Attention; Conception; Abstraction; Association of Ideas; Memory; Imagination; Reasoning.* Under the last-named head, Reasoning, he discusses matters principally appertaining to Logic; the nature of Belief, Evidence, Demonstration, the Aristotelian Syllogism, and Induction.

These two schemes are liable to a common objection. They are not an analysis of our intellectual operations; they do not separate the intellect into its different functions, supposing it to have a plurality of functions. They are merely the popular designations for the employment of the intellectual powers in certain distinct departments of exertion; as, for example, Imagination for Fine Art, Reasoning for Science, Memory for intellectual acquisition generally. They farther agree in containing matter irrelevant to the science of mind.

Reid is specially chargeable with the anomaly of including the feelings of Beauty, &c., in the intellect. The only remedy for this would have been to adopt the threefold partition of the mind.

Stewart has committed the irregularity of placing an exercise of volition among the intellectual faculties, namely, Attention. In introducing the Association of Ideas, he has fallen into the error, pointed out by Mr. Bailey (Letters on the Mind, First Series, p. 72), of placing the same subject on two foundations. The Association of Ideas, if good for anything, is competent to supersede Memory, Reason, Imagination, &c., by explaining all the phenomena that they severally imply. It cannot, therefore, be co-ordinate with these powers.

Sir W. Hamilton gives six Intellectual Faculties; *Presentative*, including the Senses, and Self-consciousness as the knowledge of mental phenomena; *Conservative*, or Memory; *Reproductive*, depending on the Laws of Association; *Elaborative*, or Abstraction and Reasoning; *Representative*, or Imagination; and *Regulative*, which includes the instinctive sources of truth. The first of these, the *Presentative*, recognizes the senses as the first source of our ideas, and is merely another form of prefacing Intellect by Sensation. The second department of the Presentative relates to the knowledge of mental, or subject states, as sensation is supposed to relate to object states. In like manner, Stewart thought it necessary to specify the source of our mental knowledge, by giving 'consciousness' at the head of his enumeration. There is a theoretical completeness attained by this plan; but the explanation in detail of the nature of the self-conscious, or introspective, faculty is inadequate in both writers. It is a matter of great subtlety. I have endeavoured to handle it, to the best of my power, in a late stage of the exposition of the Intellect. (Contiguity, § 71, p. 442.)

Hamilton's *Conservative* Faculty, viewed by itself, would be another name for Memory or Retentiveness. But when we take this with the third in the list, the *Reproductive*, including the Laws of Association, a very serious objection arises. Of Conservation apart from Reproduction, we know nothing. That I have a thing in my memory, means that, on a certain prompting, I can reproduce it, or make it present. Conservation without reproduction would be a nonentity; reproduction carries with it whatever we mean by conservation. Then, the criticism above made with reference to Stewart's 'Association of Ideas,' applies equally to Hamilton. If he makes Reproduction a power of the mind in the sense of Association, he might explain by means of it the *Elaborative*, or Scientific, faculty, and the *Representative*, or Imagination. By the *Regulative* faculty, Hamilton means what Reid calls Common Sense, or Instinctive Judgments, and what has also been called the 'Reason,' in a certain peculiar acceptation, in which it renders the Greek νοῦς, and the German *Vernunft*. It is the source of the *à priori* principles of the mind; and Hamilton discusses under it the 'Law of the Conditioned,' which he more especially developes into a theory of the instinctive belief in Cause and Effect. This law corresponds in a great measure to the principle of Universal Relativity, a principle applied, in like manner, by Mr Spencer, to the theory of causation. (First Principles, p. 241.)

Mr. Bailey's classification of the powers of the Intellect is given above (A). He proposes a division into four genera, with species under each. I. *Discerning*, divided into Sense-discernment, and discernment not through the senses. This corresponds to Sir W. Hamilton's Presentative Faculty. Under the second kind of discernment, I presume he would include introspection, or self-consciousness. II. *Conceiving*—that is, having ideas or mental representations. There are three species of this power. (1.) Conceiving without individual recognition. (2.) Remembering, conceiving, with individual recognition. (3.) Imagining, or conceiving under new combinations. III. *Believing*, (1.) on evidence, and (2.) without evidence. IV. *Reasoning*, of two kinds, Contingent and Demonstrative.

As Mr. Bailey has not made this scheme the basis of a full exposition of the mind, we are not in a position to judge fully of its merits. I should be disposed to differ from him as to the placing of Belief among intellectual operations, for reasons stated elsewhere. Apart from this, the classification is open to the same objection (if the author would consider it an objection) as all the foregoing; there is no analysis of the ultimate and distinct properties or functions of the intellect; the divisions are not mutually exclusive. Imagining and Reasoning are not separate functions, but the same functions and powers applied differently. It seems to me requisite to present such an analysis, in the first instance, in order to see what our intellectual powers really are; and then to trace the workings of these in such operations as Memory, Reasoning, and Imagination.

Mr. Spencer, in his Essays (Second Series, p. 139), has indicated a classification to the following effect. He speaks of the Intellect under the name of COGNITIONS, which he defines as the *relations* subsisting among our Feelings, and divides into four sub-classes. I. *Presentative Cognitions*, by which he means the localizing of sensations in the body, as in knowing, when hurt, what is the part affected. II. *Presentative-representative* Cognitions, by which is meant the perception of things in wholes from the sensation of some of their other constituents, as when the sight of an orange brings to mind all its other attributes. III. *Representative* Cognitions, including all acts of recollection. IV. *Re-representative* Cognitions, including the higher abstractions formed by the assistance of symbols, as in Mathematics.

I can have little doubt that when Mr. Spencer expounds this classification in detail, he will do much to elucidate the workings of the intellect. But, with the fullest deference to his philosophical acuteness, I consider that it proceeds from a mistaken point of view. In the science of mind we have to deal not with cognitions, things cognized, or the products of cognition, but with the *cognitive powers*, with the forces, functions, or attributes of mind called intellectual. A classification of our cognitions may throw light upon the cognitive powers; we must make use of them in illustration, but what we have mainly to deal with, is the process, or the means of arriving at those cognitions. The means are, as I believe, and as Mr. Spencer would admit, the three primary powers of Difference, Agreement, and Retentiveness. Consequently I consider that the unfolding of the mechanism of the intellect consists in the systematic exposition of these powers, and in the reference to them of all the popularly recognized faculties. I know of no other plan that has an equal likelihood of being comprehensive and exhaustive of the phenomena. Such a scheme as Mr. Spencer's would answer certain partial ends; it would probably discuss once for all some important notions, such as Space and Time, whose derivation is, in this volume, broken up and scattered over different parts of the work. But, until actually shown by him to be capable of introducing, in a full and systematic way, all that I consider essential to an exposition of the Intellect, I doubt its adequacy for this end.

POSTSCRIPT.

Review of Darwin on 'Expression.'

MR. DARWIN, in his recent work, entitled 'The Expression of the Emotions in Man and Animals,' has made very considerable additions both to the facts and to the theories of Emotional Expression, a subject handled at some length in the present volume. I propose to compare his conclusions with the views given in my chapter on the Instincts.

The large mass of observations in Mr. Darwin's volume will have a permanent value, even although the theories arrived at by him should be considerably modified. The worth of his compilation is greatly enhanced by his candour and fairness in stating whatever facts have come to his knowledge, whether they agree or conflict with his general conclusions.

Three principles are put forward as summing up the facts.

The first is entitled 'The Principle of Serviceable Associated Habits.' As an example, a frown accompanies and expresses states of pain, of anxiety, of deliberation, because it was originally useful in screening the eyes from the sun in circumstances of anxiety.

This principle implies three assumptions:—(1) Voluntary movement, or movement for ends, is an earlier fact than Emotional or purposeless movement. (2) Voluntary movements become associated with the feelings that occasioned them, so as to be manifested although there is no proper act of the will. (3) These associated movements are transmitted by inheritance. This last is the carrying out of Mr. Darwin's own doctrine of Evolution.

The second principle is called 'Antithesis,' and is intended to account for certain cases where an expression is stimulated, not by a positive association with the feeling, but by a motive of antagonism or contradiction to some established expression of the opposite feeling. Thus, a dog, in a savage mood, has certain movements and gesticulations positively associated with his angry and aggressive passion, being the incipient movements of a destructive onslaught; a dog, in an affectionate mood, not having a positive endowment corresponding to affection, chooses the most exact contrast or opposition to his angry demeanour.

The third principle is 'The principle of actions due to the constitution of the Nervous System, independently of the will from the first, and independently to a certain extent of Habit;' more briefly, it is stated as the principle of 'the direct action of the nervous system.' The reader of the present work will recognise in this what I have termed the Law of Diffusion. Mr Darwin quotes the statement I have given of the law, and remarks that it 'seems too general to throw much light upon special expression;' which is quite true; nevertheless, he himself employs, for that very purpose, a mode of stating it that I believe to be still more vague.

The order of these principles is the inverse, or analytic order, which is, on some occasions, more convenient than the direct or synthetic. If we were to start from what is primitive or primordial, we should begin with the last-named principle, 'the direct action of the nervous system.' The two others are subsequent and superinduced upon this; more especially is that named first, which is the author's own law of Evolution or Inheritance, a later effect—or a growth or addition to the simpler process of nervous diffusion. The characteristic feature of the book is the applying of Evolution to account for the phenomena of expression. The two other laws are less often appealed to. Wielding an instrument of such flexibility and range as the inheritance of acquired powers, a theorist can afford to dispense with the exhaustive consideration of what may be due to the primitive mechanism of the system; he is even tempted to slight the primitive capabilities, just as the disbeliever in Evolution is apt to stretch a point in favour of these original capabilities.

In the present volume, I have not made use of the principle of Evolution to explain either the complex Feelings or the complex Intellectual powers. I believe, however, that there is much to be said in behalf of the principle for both applications. In the third edition of 'The Emotions and the Will', now in preparation, I intend to discuss it at full length. My present object is to compare Mr. Darwin's theories of the origin of Emotional expression with the views given in the present volume; to see how far my explanations cover the ground, and at what points they seem to come short of the facts, leaving the field open for the new principle.

My readers are aware that I put great stress upon two primitive tendencies of the system, besides Diffusion, namely, the Spontaneity of Movements, and the Law connecting Pleasure and Pain with augmented and lowered vitality. Now both of these powers enter, with marked prominence, into the expression of the Feelings. Mr.

Darwin never mentions the doctrine of Spontaneity; he alludes to my statement of the Law of Pleasure and Pain, without saying whether he agrees or disagrees with it in the general formula; but in his detail of facts, he adduces many examples of it so striking that he cannot help expressing them in the phraseology of the principle. His second law, the law of Antithesis, to a small extent coincides with the law of Pleasure and Pain; but it is ill-fitted to supersede that law, as I will endeavour to show.

Conceiving as I do, that the Spontaneity of Movements is a great fact of the constitution, with important consequences both emotional and volitional, I will here point out its bearings on Expression. In so doing I must define precisely what it consists in, and how far it reaches.

By Spontaneity, I understand the readiness to pass into movement, in the absence of all stimulation whatever; the essential requisite being that the nerve centres and the muscles shall be fresh and vigorous. We may never in our waking hours be wholly free from the stimulation of the senses, but in the exuberance of nervous power, our activity is out of all proportion to the actual solicitation of the feelings. The gesticulations and the carols of young and active animals are mere overflow of nervous energy; and although they are very apt to concur with pleasing emotion, they have an independent source; their origin is more physical than mental; they are not properly movements of expression; they express nothing at all, except an abundant stock of physical power.

To obtain a correct estimate of the expression of joy, for example, the spontaneity must be allowed for and subtracted. This may not be very easy; yet the separation of the two facts is quite supposable, and is occasionally realized. The spontaneity concurs with morning freshness, or with the outburst after confinement, and will show itself in the absence of pleasurable stimulants; although these would operate in the same direction, and the two effects would be indistinguishable. The expression of pleasure is shown in isolation when the flush of spontaneity has passed by, when a certain amount of exercise has drawn off the exuberant and surplus energy of the system; it is also shown in constitutions so languid or inactive as never to have any surplus.

In the following passage Mr. Darwin obviously combines spontaneity with joyful expression, "Under a transport of Joy or of vivid Pleasure, there is a strong tendency to various purposeless movements, and to the utterance of various sounds. We see this in our young children, in their loud laughter, clapping of hands, and jumping for joy; in the bounding and barking of a dog when going to walk with his master; and in the frisking of a horse when turned into an open field." The first case—the demeanour of children—is usually a mixture of exuberance and sportive pleasure; the second—the dog walking out—contains a known element of pleasure; the last—the frisking of the horse—is almost pure spontaneity, it does not necessarily express Joy or Pleasure at all.

The course taken in the spontaneous outburst of movements is the most usual or habitual channels of activity. The locomotive muscles are the first to be affected: actions that may have become habitual in the pursuit of ends are excited purposelessly when the system is fresh. Running, jumping, shouting, talking, may be induced in this way. Any special trick or practice may be incited; as when the dog, after relieving himself, vehemently scratches the ground. Survivals may be maintained by no other exercise than what is stimulated under the spontaneous discharge of activity. Assuming the scraping of the dog to be an action once useful, but no longer so, it would fall into disuse but for its being repeated in the moments of abounding energy.

The most frequent mode of displaying exuberant force is in following some pleasure that chances to be at hand, in itself perhaps trifling, and at other times utterly neglected. Finding ourselves in possession of productive energy, we seek occasions for turning it to account; if great opportunities do not present themselves, we are content with small. This is one aspect of *play*, in children and in playful animals. The kitten is not seriously in love with a worsted ball, nor a dog with a stone; but under superabundance of nerve force these trifling objects are magnified so as to become an inspiring pursuit. There is an exact parallel in the desultory activity of men by nature incontinently energetic.

The spontaneity due, not to natural exuberance, but to excitement, is equally devoid of meaning as regards feeling or emotion. The nervous centres are profusely active, and that is the whole fact; the concurrence of some degree of pleasure or of pain does not alter the situation, although helping to complicate it. The causes of excitement are numerous; there may be a mental state accompanying it, but the physical outburst does not represent a mental mood, it only gives evidence of the molecular energy of the nervous centres.

A man under excitement paces his room, to and fro, sits down and starts up; never rests in one posture. The excitement may be attended with pleasure or with pain, with love or with hatred, but these are not what the demeanour expresses. If the precise mood is expressed at all, it is by some display superadded to, and distinguished from, the general excitement. The extreme case is delirium; in which the violence of the movements has nothing answering to it in the mental condition; the delirious patient being often unconscious.

As with natural exuberance, so with excitement, the movements are chosen and determined by the habitual channels of the nerve force, due to the circumstances regulating the life and activity of the individual. Inasmuch as locomotion is the prevailing mode of action, with all animals, excitement tends by preference, to rapid locomotive efforts. With excited human beings, the upper extremities gesticulate in some of the usual and characteristic actions, as in going through the formality of striking a blow.

I will now advert to Mr. Darwin's handling of what I have been accustomed to style the Law of Diffusion. It is explained at at length in the introductory chapter of 'The Emotions and the Will.' By Mr. Darwin, the general principle is expressed thus:—'When the sensorium is strongly excited, nerve-force is generated in excess, and is transmitted in certain definite directions, depending on the connexion of the nerve-cells, and partly on habit; or the supply of nerve-force may, as it appears, be interrupted.' This statement does not sufficiently distinguish the excited spontaneity of the centres, from the effects due to a feeling. The proper law of Diffusion supposes a sensory stimulus—as light, sound, an odour—affecting the nervous centres, and, while accompanied by a state of pleasure or pain, inducing a wave of movements and other effects by the outgoing nervous current. The start from a sudden shot exemplifies the diffusive nervous action; and the general law of that action, as more explicitly promulgated by Mr. Herbert Spencer, is that the diffusive display, the energy of the gesticulation and movements, is directly as the intensity of the stimulus or shock; a feeble sound, unexpected, gives a slight disturbance; a loud sharp sound causes a violent start (Psychology, I., 92).

Mr. Darwin, in his concluding expression, "the nerve force may be interrupted," allows for the cases where the severity of a blow paralyzes the nervous system.

It is true of the diffusive display caused by stimulating one of the senses, or by some emotion anyhow arising, as of the spontaneous discharge, that the channels selected by it will depend upon the structural connexions of the nerve centres, whatever may have brought about those connexions. Nevertheless, diffusion in response to a sensory or emotional stimulus, is more specially limited than spontaneity; and hence the expressiveness and character of the movements under feeling. We shall see what are these various guiding and limiting circumstances.

The following are a few of the instances where Mr. Darwin adverts to diffusion, or direct nervous actions:—He adduces, first, the sudden change of the colour of the hair, under terror or grief, as a case in point. He next brings forward a number of instances connected with the extreme forms of pain and terror, and dwells particularly on the muscular tremblings in fear. In contortions of pain, he remarks, that nearly every muscle of the body is brought into violent action; admitting, however, that much of this excessive action is due to the promptings of the will to mollify the pain. Again, many of the signs of rage (not all), he attributes to the direct action of the excited sensorium; not only the gestures and movements, but also the influence on the heart's action, and the circulation of the blood. Farther, joy quickens the circulation, and this stimulates the brain, which again reacts on the whole body. Also, terror, in all animals, causes tremblings of the body, relaxes the sphincter muscles, disturbs the heart and the breathing, and leads in the end to utter prostration, and even fainting. Pain and fear, if great, are depressing; if not so great, they are stimulating. These are the leading instances in the chapter expressly devoted to the principle of direct nervous action. A few scattered references occur in other chapters: the lashing and curling of the tail in animals under excitement (126); the sympathetic action of unnecessary muscles, along with those that are at the time necessary (166), as in closing the eyes, and the mouth.

These examples are obviously complicated with the effects special to pleasure and pain; they are the very cases that I have always adduced in support of my view of the law connecting increased vitality with pleasurable, and diminished, with painful emotion. The best example for diffusion by itself is Surprise or astonishment; there being numerous instances of surprise without any marked degree of either pleasure or pain.

It would appear, therefore, that the principle of 'direct action' cannot be carried to any length, without raising the question as to the distinctive modes of expression under pleasure and under pain. Either the diffusion is the same, in degree and in character, whether the primary shock be pleasing or painful; or there is a difference. If there is a difference, what is it? Until this question is probed to the bottom, everything is vague.

Mr. Darwin, in describing particular instances, occasionally notices the invigoration attending pleasure, and the depression and exhaustion often attending pain, notwithstanding its being a stimulus to activity. He remarks the contrast in nature between the so-called exciting and the depressing states of the mind (78). 'Under the expectation of any great pleasure, dogs bound and jump about in an extravagant manner, and bark for joy' (122). Monkeys tremble for fear, void their evacuations, and almost faint (146). The screams, groans, and writhings of extreme pain, are followed by profuse sweating, pallor, trembling, utter prostration, or faintness (147). After excessive grief, 'the circulation becomes languid; the face pale; the muscles flaccid; the eyelids droop; the head hangs on the contracted chest; the lips, cheeks, and lower jaw sink; the features are lengthened, the face is said to fall, (178). In high spirits, a man holds his body erect, his head upright, and his eyes open (212). 'With all the races of men, the expression of good spirits appears to be the same' (213). A similar strain of observations occur in Sir Charles Bell's work on Expression.

It is only under his principle of Antithesis that Mr. Darwin makes any attempt to generalize the contrasting expression of pleasure and pain. Indeed the chief examples that lend an unequivocal support to that principle are examples coming under the present head. I will, therefore, now review his mode of expounding that principle.

'Certain states of mind lead to habitual movements which were primarily, or may still be, of service; when a directly opposite state of mind is induced, there is a strong and involuntary tendency to the performance of movements of an opposite nature, though these have never been of any service.' Such is the principle of Antithesis. It is illustrated in the first instance, by a reference to the lower animals; and the leading example is from the dog, who has attained, by hereditary transmission, the attitude and actions belonging to the aggressive mood; but has no such hereditary endowment for affection and fondness; what he does, therefore, when his affection is roused, is to reverse all the aggressive movements. The movements of the cat, under the two opposing states—hostility and affection—are represented to have the same exact antithesis. The great example in man is the 'shrugging the shoulders,' which is stated as the reverse, in all particulars, of the indignant and defiant attitude. The other scattered allusions to the principle of opposites are almost pure examples of the opposition of pleasure and pain.

On the leading case—the opposition of rage and affection in the dog and the cat—I offer the following remarks:—

First, the contrast here is not a simple contrast of opposing states; it represents two separate developments, each springing from its own independent circumstances, notwithstanding that, when developed, there is an antagonism between the two. The simple contrast, the obverse implication, of a state of aggressive rage, is the state of collapse and dread under a still more powerful aggressor. Between the beater and the beaten there is an immediate and direct opposition; the mental condition of the one is the natural obverse of the mental condition of the other; and the physical attitudes should show a corresponding opposition. The mind of every fighting animal has passed through both phases; as with heat and cold, the experience of both is necessary to the experience of each. If we could suppose an animal that had never known fear, doubt, inferiority, the fact or the notion of being beaten,—such an animal would not have the fully developed consciousness of the condition of rage, indignant defiance, bellicose passion; its encounters with resisting prey would be purely mechanical, like tearing up a root or climbing a tree.

So then, the antithesis to be examined is between angry superiority, and tamed or frightened inferiority; and this is sufficiently marked in all the manifestations. It is, however, a pure example of the antithesis of pleasure and pain, of elation and depression, qualified by the situation of contest.

In the next place, I must remark that Mr. Darwin's supposition of a state of affection arising without its physical concomitants, and borrowing or evoking these by a conscious or unconscious reversal of the attitudes of anger, is at variance with the very first principle of the relationship of mind and body; a principle, acknowledged by himself, although with hesitation and timidity. The development of angry passion involved with it a concomitant physical state; the two must come together; the mental cannot subsist without the bodily. This is true of Rage; and it is equally true of Affection. The affectionate mood cannot exist without an express physical support; and as the capacity and the intensity of affection advances, so do the physical embodiments characteristic of the state. We are not first made affectionate in our purely spiritual half, and then left to find out a suitable expression, in the best way we can; we cannot be affectionate in any degree, without having at the same time the movement, the yearnings, the glandular effusions, for manifesting the affection. The power of *expressing* our feelings, is merely an incident of their indispensable physical support.

Because animals from their fighting life contracted angry passion, with its accompanying attitudes, it does not follow that they should contract the affectionate moods; indeed, the one must necessarily preclude the other. If they ever become affectionate, it is because, in certain situations, they derive gratification from acts that require them to court, cherish, and uphold others of their own kind. The necessities of subsistence make them aggressive; love makes them fond and affectionate. The two interests are not a mutually-implicated couple, they are as distinct as Taste is distinct from Hearing; their contrast or opposition is shown only in their outgoings or consequences.

To advert now to shrugging the shoulders, as an example of Antithesis. I cannot help remarking how in Mr. Darwin's own description there creeps out the opposition between aggressive energy and helplessness, which is merely an offshoot of the great antithesis of elating and depressing passions—of pleasure and pain. The indignant energetic man holds his head erect, frowns, closes his mouth, squares his shoulders, expands his chest, clenches his fists, stiffens the muscles of limbs: the helpless apologetic man releases all these attitudes; his only positive exertion is the lifting of the shoulders (chiefly one shoulder) and the turning outwards of the open hands. So far as I can venture an opinion upon the lifting of the shoulder to meet the inclining head, I would connect it with the general crouching attitude in the helpless and defenceless; the meaning of which may be to make one part of the body cover the other parts, so as to diminish the exposed surface. Pure antithesis, in my view of it, simply releases movements, it does not originate counter movements; these are due to some action of the will, direct or indirect, to suit a purpose.

From this review of Mr. Darwin's two principles—namely, Direct action of the Nervous System, and Antithesis—it appears that he has, without explicit avowal, assumed the operation of the law that connects Pleasure with physical elation, Pain with physical depression. I hold that this law, if true, should appear at the very front of every theory of emotional expression; and that it is true (with suitable qualifications) I believe there is the strongest evidence. In the present volume, I have given the proofs at length; and I have just cited additional examples from Mr. Darwin himself.

Indeed if this principle is not true, there is no consistent relationship between mind and body. Pleasure and Pain are opposite states, as much as plus and minus, hot and cold, wet and dry; the one negatives the other. Any person reflecting on these two facts, namely, that pleasure and pain neutralize each other, and that they move the will in opposite ways—must admit their total contrariety. Now, if there be any harmonious principle in the the union of the mental and the physical, contrary mental states should correspond to contrary physical states. For contraries, we need only one explanation. Whatever be the physical condition corresponding to a state of pleasure, an opposite condition should correspond to pain. If pleasure is concomitant with the elation or invigoration of some vital process, pain should concur with depression or enfeeblement. Or, further, according to the supplementary law of Stimulation, pleasure is the expending of nervous power from a full stock, pain is either no expenditure at all when there is abundance (ennui) or expenditure beyond the proper limits. It may be that pleasure consists in a certain *manner* of expenditure (not too sudden, or violent); pain will then consist in the opposite manner: we do not at present know what is the precise difference between a sweet and bitter taste, whereby under the same nervous condition, the shock of one is pleasant in all degrees, the shock of the other painful, in all degrees.

If we were dealing with *neutral* stimulants, those that merely rouse up consciousness, without either pleasure or pain, the law of Direct action (Diffusion) would be enough. But neutral stimulants of any considerable degree of intensity are not frequent; with the neutral excitement there is usually either pleasure or pain. Hence we can never lose sight of the need of qualifying direct nervous action by that law; pleasure as such elevating the physical tone, pain as such depressing it.

To show the various cautions that are needed in following out the Law of Direct Action, which Mr Darwin (as well as Mr Herbert Spencer) in my opinion, regards too exclusively, I will select a few typical cases, of pleasure and pain, such as we are all familiar with.

1.—A slight shock of acute pleasure—a pleasant relish or taste, a sweet perfume, a melodious note, or the opening up of the clouds to a sunny ray. The physical outburst corresponding to one of these mental stimulants is cheerful, animated, enlivening, in but a slight degree. To a young, vigorous, or demonstrative person, even a small pleasure will lead to a certain impetuosity of display; which will be the more apparent that there is no pre-engagement of body or mind. To a quiet, or feeble subject, the exhilaration will be more inward, or in the flow and direction of the thoughts; which is still an evidence of power evoked. Perhaps, the pleasure may fall on a mind already depressed; in which case, the effect will be lost in slightly abating the dejection.

2.—A pleasure of greater magnitude, and persistency—a decided accession of some acute pleasurable stimulation: such as a stirring piece of music, a noble prospect, an agreeable companion. All the language used for the first case, can be applied here heightened for degree. The demonstrations will be more powerful and persistent. In case of previous gloom, there may be power enough to restore the mean state, with or without surplus. The vigorous and robust will put forth outward manifestations; the less demonstrative will take on a cheerful cast of thought.

3.—An occasion of multiplied and concurring pleasurable impressions:—a great feast, with dainties, music, and company; a joyful celebration. Under this, every one is roused into active displays of elated emotion; the quietest temperaments have that inward thrill that bespeaks force profusely, and yet not exhaustingly, awakened.

4.—Elation of tone gradually acquired, and unaccompanied with acute shocks or sensations :—mere health, replenishment with food, stimulants, successes, bright hopes. Here there may be no violent demonstrations ; only a gentle activity, an erect attitude, a disposition to converse, to love and to be loved, a readiness for exertion, as if under a refreshing stimulus.

This last case opens up one aspect of voluminous or massive pleasure—namely, its being serene, soothing, quieting—as opposed to the rousing or stimulating pleasures, which are mostly acute. The physical side of such states may seem to be an exception to the law; as there is a lowering instead of a quickening energy. Thus muscular repose and sleepiness, if yielded to, are massive pleasures; yet they are accompanied with decline of energy. There is, however, no real contradiction. It is the very nature of the state to grow out of a muscular lull; this is its basis. So far as compatible with that essential condition, the pleasure is accompanied with its quota of enlivening accompaniments; the reposing labourer has a remnant of force enough for a cheerful demeanour.

Now for Pains :—

1.—A slight smart, an acute shock—the stroke of a whip, a bitter taste, a sudden mal-odour, a screeching noise, a glare, a small disappointment or failure. The shock being sudden, and the system vigorous, this is the occasion for the lively demonstration that seems most at variance with the law of Pleasure and Pain. The individual is wakened up to a very active display; he starts from head to foot, falls into a brisk walk, gesticulates, and seems prepared for great deeds.

2.—Let the shock be much greater—a more serious blow, but still acute ; and let the subject possess great physical vigour at the moment. There will still be a lively and energetic outburst, and the appearance as if the greater intensity of the shock made a proportional intensity of the diffused manifestations. This is only, however, on the supposition of a fund of vigour in the individual. Let the case be a weak or exhausted subject, and this second degree of stimulation is the reverse of invigorating, even in appearance ; it induces prostration, loss of strength, quiescence under a pain still rankling.

3.—Suppose next an accumulation of painful shocks at many points—a shower of missiles, a stroke with the cat-o-nine-tails. It is only for a moment, and in a robust subject, that this more terrific infliction can be followed by active manifestations. According to the uncorrected law of Direct Action, it ought to inspire a giant's fury ; in point of fact, it is simply overwhelming, crushing, utterly prostrating. The delusive appearance of strength, under a moderate smart, is no longer seen, even to a trifling degree. Very strong men, at the halberds, keep up energetic gesticulations for a short time; but, although, these are supposed to mitigate the agony, by diverting the nervous force, they soon die away.

4.—Keeping still the obverse parallel of the instances of Pleasure, I take now the case of general mental depression, without acute inflictions: as cold, hunger, fatigue, danger, defeat, mortification, remorse, despair. The physical side here is weakness, depressing enervation, without any redeeming circumstance, or the pretence of activity. Some special inspiration is requisite to waken up the powers under massive depression and gloom. Our general law is seen without any distorting or misleading appearances.

5.—A very special and highly illustrative case, is the irritation of a sore, or a 'raw;' than which, nothing is more destructive of vital energy. The tearing open of a wound, or a protracted surgical operation, induces fainting and sickness—the culminating term of the debilitated nervous centres. Something of the same prostration follows a blow on the more sensitive organs—the eye, the nose, the ear, the stomach, the testicle in men, the breasts in women.

The properly Emotional expression, or manifestation, of the Feelings, is constantly mingled with pure and proper volition; and especially is this the case with Pain. The action of the Will is loudly demanded in acute agony, first to procure relief, and failing that, to deaden the feeling by a diversion of nerve force to the muscles. Hence there is great probability in Mr. Darwin's view, that the expression of acute pain is, in its origin, volitional, or stimulated with a view to relief. The energetic gesticulation that follows immediately on pain, not too severe, or in strong subjects, may be an inherited tendency, beginning in the ordinary course of the Will, namely, to seek relief from pain by efforts proportional to its violence. It is in Will, or volition that the proportionality of action to stimulus may (with certain allowances) be fairly attested.

Before proceeding to Mr. Darwin's first and greatest law, the principle that is his crown of glory as a theorizer, I will make a passing allusion to two minor circumstances, partially adverted to by him, which enter into the explanation of our movements of expression.

The first is the simultaneous or consentaneous action of the muscles, described in the present volume (p. 268) as the law of Harmony of State of the muscular system. Yawning is quoted by Mr. Darwin as a good example. Again, in scratching a part that itches intolerably, there is a forcible closure of the eyelids; which may come under that general action by which almost all the muscles of the body are made rigid at the same time (p. 166).

The second circumstance, which a great deal might be made of, is the Limitation and Diversion of energy. The dropping of the jaw, in astonishment, is attributed to the great draft of nervous energy in supporting the active strain peculiar to the state; there is a relaxation of many of the muscles, the mouth opens, and the jaw drops of its weight (p. 284). The vacant expression of the eyes, in a mood of intense abstraction or meditation, is caused by the relaxation of the muscles that converge the eyes (p. 229). A very large number of situations might be pointed out, wherein the characteristic display is due to the loss of energy at one point through its absorption at another; as stopping suddenly in a walk, when a thought strikes us, or when about to say something emphatic to a companion.

It is under the 'Principle of Serviceable Associated Habits' that Mr. Darwin brings to bear, upon the problem of the origin of Expression, his doctrine of the Inheritance of acquired powers. He supposes the will to be a more primitive fact than Emotional Expression, at least in the various specific modes and peculiarities; for expression, according to the law of Direct Action would be coeval with the sentient organization. The first examples of the principle are taken from the lower animals. Dogs before going to sleep on a hard floor turn round and round and scratch the floor with their fore-paws, as if to trample grass and scoop out a hollow. Many carnivorous animals, as they approach their prey, lower their heads and crouch; the meaning is partly to hide themselves, partly to prepare for a rush; they do this when there is no real occasion. Dogs are well known to go through the form of covering their excrement, in circumstances wholly irrelevant; a purposeless remnant of some ancient utility. Kittens, puppies, and other young animals have been accustomed to push, with their fore feet, their mothers breasts, to make the milk flow; they do the same against a warm soft obstacle. A horse, eager to start on a journey, paces the ground; he adopts the same movement when about to be fed, and impatient for his corn.

It is, perhaps, in discussing the special Emotions, that Mr. Darwin obtains the most illustrative cases of inherited expression: the best are Anger and Fear. The gestures of Anger are the inherited attitudes of a combatant or aggressor; the sneer or snarl, which sometimes uncovers the canine teeth reveals our animal descent. The expression of Fear is connected with the violent movements for escaping danger.

I shall, however, proceed at once to his mode of accounting for the anomaly of the pained expression in the human face—the energy put forth in frowning, and in curving the mouth by the depressor of the angle. This was the difficulty that neither Sir Charles Bell nor

Müller could explain; and it is in plain contradiction to the law of pleasure and pain. The only suggestion that I have been able to offer is that a certain amount of contraction of the smaller muscles would more effectually relax the greater, as in crouching when the body is already disposed to collapse. If we are in a depressed condition, the renunciation of muscular expenditure leaves a larger share of blood to the viscera and the veins, and contributes to ameliorate the tone of mind, which is more dependent on these organs, than on muscular exertion. Now if the relaxed muscles were large, and the relaxing muscles small and lightly moved, I think there would be some gain by the positive expenditure; and this would be one way out of the contradiction of supposing that to Pleasure and to Pain there is equally attached the manifestation of physical energy. I have been disposed to think that this explanation would suffice as regards the forced collapse of the whole body; I have never been quite satisfied of its sufficiency for the face. In the face, the relaxed muscles are apparently too small, and the counteracting efforts too great to yield the required release of power in the whole.

I will now, therefore, review Mr. Darwin's explanation. And first as to the act of Frowning; performed by the contraction of the small muscle between the eyebrows, opposing the large muscle of the scalp (occipito-frontalis). The frown is primarily, and generically, an expression of pain; all its derivative applications—in anger, displeasure, eager pursuit and determination, perplexity, deliberation, and meditation—are easily traceable to this origin. Mr. Darwin has two modes of accounting for the frown. One, given also by Mr. Spencer, is the habit of shading the eyes from the sun, during very intent and anxious vision, as in scanning the horizon for an approaching enemy. Mr. Spencer puts stress specially upon the situation of a combat; we know that boxers toss for the sun; and the combatant that has the sun in his eyes is at a great disadvantage; his only resource being to draw down the eye-brows and eye-lids as a shade. We may, however, give ourselves the benefit of the wider range of situations quoted by Mr. Darwin; extending our reference to all critical occasions whatsoever, where an animal might be incommoded by too much glare.

The other explanation given by Mr. Darwin, is to assign a train or series of connected steps in the expression of the face, accounting for the entire circle of characteristics under pain, namely, shedding tears, frowning, and curving the mouth downwards. He starts with the act of screaming, as arising under pain. The exertion of the voice in pain, is originally voluntary, with a view to obtaining assistance; and is energetic, according to the necessities of the case. By inheritance, this grows to be an expression of pain under all circumstances; it ceases to be consciously voluntary, and becomes a properly emotional expression.

The exertion of screaming being thus assumed, a number of consequences arise, Mr. Darwin thinks, by physiological cause and effect. Violent screaming leads to the gorging of the eyes with blood; this is a painful effort, and the will is roused to various protective or ameliorating actions. Thus, the eye-balls are compressed, and the congestion stemmed, by the united tension of the orbicular, corrugator, and pyramidal muscles; all which we know, in point of fact, to be exerted during a fit of crying; while, at the same time, the lachrymal glands, under the like compression, give forth a stream of tears. In this group of effects, Mr. Darwin traces out (1) frowning, (2) the expression of grief in the obliquity of the eye-brows, (3) the lifting of the upper lip, and (4) the depression of the angle of the mouth. "When infants scream they firmly contract the muscles round their eyes, and this draws up the upper lip; and as they have to keep their mouths widely open, the depressor muscles running to the corners are likewise brought into strong action. This generally, but not invariably, causes a slight angular bend in the lower lip, on both sides, near the corners of the mouth. The mouth thus assumes a squarish outline. The contraction of the depressor muscle is best seen in infants when not screaming violently, and especially just before they begin, or when they cease to scream" (194).

Such is the explanation, iterated in various forms by Mr Darwin, of the greatest difficulty attending emotional expression. It hinges on two assumptions. The one is that screaming in pain has arisen from a voluntary beginning, namely, the calling for assistance. The primitive outburst of the voice would be either from spontaneity, or in the effusion of delight, or both together; to 'shout for joy' is the natural result of the primary tendencies of our being. To shout under pain, is exceptional and secondary; and supposes a sense of some end to be gained; the *habitual* employment of the scream for this end transfers it from a voluntary to a purposeless act, or an emotional expression, purely and properly so called.

The other assumption is that with the violent exertion of the muscles of the larynx and chest, there is a congestion of blood in the adjoining parts, namely, the features and the eyes. In the eyes, the gorging is especially distressing, and would by the law of the will, induce movements of counteraction; these being such as compress the eye-ball. The actions suited to the effect comprise the whole circle of movements of the features under a fit of crying; and in the milder states of pain, there would be a smaller exertion of the same parts. For example, the brow is corrugated, and the angle of the mouth depressed, without either screaming or tears.

The hypothesis is bold and original, and has the appearance of being adequate to the facts; (the most doubtful point, perhaps, is the extension of the supposed influence to the depression of the angle of the mouth). The author in addition to his own observations, adduces the authority of oculists and others, to confirm his view of the supposed sequence of cause and effect. There underlies, of course, the wider hypothesis of Inheritance of acquired modifications, granting which we may readily allow that the explanation is feasible and probable. A more critical and advanced physiology may find flaws, and perhaps also make good defective links; while, at the present moment, any one rejecting the hypothesis will have some difficulty in supplying its place with one equally adapted to the problem to be solved.

Mr. Darwin's theory of Blushing is one of the happiest suggestions in the book. He carefully surveys the facts; ascertains when children begin to blush, what are the exact limits of blushing in the body, and how far the different races of mankind are liable to blush. He describes the movements and gestures of the body that accompany blushing; and remarks that the state is usually attended with some degree of mental confusion. He enquires into the antecedent mental states and emotions, and enumerates as the chief, shyness, shame, and modesty; the essential element in all being *self-attention*, more especially as directed to *personal appearance*, and above all to the *face*. To explain the origin of the effect, he refers to a physiological principle which has of late years been brought into view by various observers,—that attention closely directed to any part of the body tends to interfere with the ordinary and tonic contraction of the small arteries of that part; so that the capillaries, in consequence, became enlarged and congested with blood.

In order to establish his theory, he recites a number of the facts illustrating the debilitating effects of intense self-consciousness of the bodily processes; but I am disposed to think that the examples adduced do not all belong to one law.

I have discussed at length (p. 336) the process of acting out an idea, or the tendency of ideas, in so far as allowed, to become full realities; as when the idea of some crime that has been prepetrated operates upon weak minds to make them repeat it. This principle embraces the influence of ideas on mesmerized patients; it also embraces the production of the physical accompaniment of a sensation, by means of the ideas strongly suggested to the mind; as salivation at the sight of food.

The consequences of the principle are sometimes beneficial or agreeable, sometimes disagreeable, according to the circumstances.

The idea of something pleasing, as a feast, is itself pleasing or exhilarating; the actualizing of agreeable ideas is agreeable, and obversely.

The problem of blushing, however, requires a painful agency; and if it comes under the foregoing law, it comes under its painful aspect. But a prior question occurs, is the tendency to raise an idea into actuality, the same as the tendency of self-attention to debilitate the parts attended to? Let us examine this case by itself. I have adverted, in an Appendix Note (p. 685), to the contrast between Objective and Subjective regards; the one being invigorating and stimulating, the other relaxing or depressing. Of this, as a general fact, there can be no doubt; although no explanation has as yet been given of it, the fact itself has been accredited by general observation. Sir Henry Holland and other physicians have remarked that attending to the sensations of digestion impairs its power for the time; that the process goes on better if the attention is wholly withdrawn from it. Mr. Darwin quotes a patient of his father's who when he felt his own pulse, found it irregular; when felt by the physician, it was perfectly regular. In these cases, however, we can hardly say that there is the carrying out of an idea into actuality. There may be instances, where a patient has a preconceived idea about himself—that his heart is diseased, or that his digestion is bad—and by dwelling on the idea, may induce something of the reality. Still that is not the same as salivating at the sight of food. It would be paralleled by salivating from thinking of the glands or the saliva. The essential point is not the having an idea, and working it out in its proper character, but the concentrating of attention on some part of our own body or of the mind. To be thinking of self is the main fact; and the general consequence is some debility or derangement in the functions of the part; there is relaxation of the vaso-motor stimulus of the vessels, with local congestion, which amounts to functional weakness, if not disease. Among the records of Medicine and Pathology, more special consequences are assigned; but this is the general result. Sometimes, although not often, a healthy action has been attributed to the self-reflecting operation; as when the catamenial flow has been stimulated by thinking intently on the operation; and in the influence of imaginary physic. From such instances medical men have supposed that a curative power may be found to be wrapped up in the influence of the imagination; but the cases that favour this supposition turn chiefly upon a principle different from either of the two now in discussion, namely, the power of hope, belief, or sanguine anticipation—a state favourable to healthy action, on the law of Pleasure and Pain.

I apprehend, therefore, that Mr. Darwin's explanation of blushing rests upon the *debilitating effect of self-consciousness*.. This effect can be to some extent localized; attending strongly to the stomach, affects digestion; attending to the heart's action disturbs the pulse. The localizing operation has something to do with our ideas, but not with the actualizing of an idea. As pain and derangement are the occasions of our most earnest attention to our bodily organs, the act of attending to them may possibly induce an unhealthy state of the circulation. So it is, however, that when we are in our best condition of bodily and mental vigour, our regards are objective or outward.

Granting then the principle of self-consciousness as affecting the vaso-motor system, how does it apply to blushing? Thus:—When we are very much stared at by others, we are led by imitation and by solicitude to think of our face; the moment we think of it, we feel it growing warmer; this is the weak form of blushing—the lower degree of congestion, blushing being the higher. In some individuals, the congestion readily assumes the higher degree seen in reddening, or of the blush proper. The area of the blush corresponds to the parts of the body usually exposed to the public gaze.

MAY, 1873.